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AN ANALYSIS OF RETENTION RATES AND DEMOGRAPHICS OF GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY

THESIS

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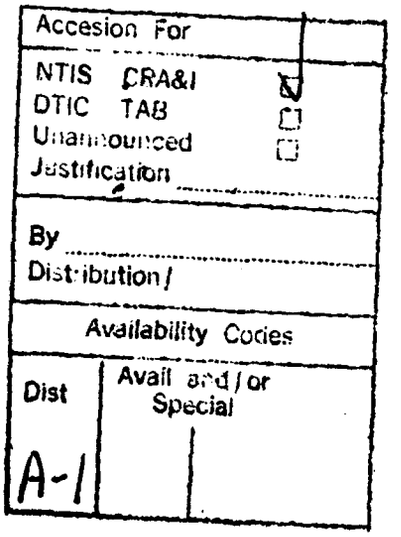

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AN ANALYSIS OF RETENTION RATES AND DEMOGRAPHICS OF GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY

THESIS

Presented to the Faculty of the School of Systems and Logistics

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Master of Science in Systems Management

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Abstract

This study analyzes the retention rates and demographics of Air Force Institute of Technology (AFIT) graduates. The sample includes 5,071 Air Force officers graduating between 1973 and 1987. Actual retention rates of AFIT graduates are compared to retention rates of mission support officers provided by the Air Force Military Personnel Center. A proportional hazards regression analysis is performed to study the relationship between specific factors and a graduate's length of service after graduating from AFIT.

The results of this analysis show that graduates of the School of Engineering (EN) are nearly two years younger, on average, than their counterparts in the School of Systems and Logistics (LS), and remain in the service an average of two years less than LS graduates. Comparisons of the actual and expected retention rates of AFIT graduates show that the retention rate for AFIT graduates is significantly higher than the USAF at large. The results of the proportional hazards regression analysis show that GPA, age at graduation, and in some cases, sex and aeronautical rating are significant factors influencing retention.

AN ANALYSIS OF RETENTION RATES AND DEMOGRAPHICS OF GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY

I. Introduction

Overview

This study compares the retention rates of Air Force Institute of Technology (AFIT) Air Force officer graduates to those of otherwise similar Air Force officers. Additionally, this study provides descriptive statistics regarding these officers and analyzes the relationship between the retention of AFIT officer graduates and their demographic characteristics.

General Issue

The retention of quality personnel is essential to any organization. The loss of highly trained personnel can have significant adverse impacts on an organization due to the loss of productive resources and the necessary costs associated with filling vacant positions and training replacement personnel. The objective of the Air Force, however, is not to retain every officer in the service until eligible for retirement, thereby minimizing replacement costs; in fact, certain levels of losses are planned for by the Air Force. The true objective is to retain the proper profile of officers with respect to age, rank, skill level, and experience. The Air Force, like its sister services, makes substantial investments in its officers, offering additional training and master's degrees to selected personnel. Other retention inducements include; 20-year retirement eligibility, competitive income, annual pay raises, free medical care, thirty days of annual leave, and various recreational benefits.

Personnel Policies and Fiscal Constraints. Military force size is contingent on fiscal constraints. Force levels are regulated by controlling the flow of accessions, establishing promotion requirements, and by normal attrition. In more austere times, such as those we are currently experiencing, force shrinkage may be achieved by encouraging voluntary separations and by involuntary reduction in force (RIF) actions. Because of the current fiscal constraints placed on the military budgets, the Air Force is planning to cut its force size 20 percent by FY95 while maintaining force quality (10:36).

Graduate Education in the Air Force. Air Force officers usually obtain graduate education through one of three avenues. First, the majority obtain their graduate degrees by attending civilian schools as part-time students. This group is eligible to receive some tuition assistance. A second group is sent by the Air Force to civilian schools as full-time students with their tuition and salaries paid for by the Air Force. Third, some officers are sent full-time to the Air Force Institute of Technology (AFIT). This institute is maintained by the Air Force to offer various degree programs which contain elements unique to the military. Master's degree students attend for fifteen to eighteen months depending on their program. During this time, they draw their usual pay and allowances and pay no tuition.

Part-time graduate students are eligible to be reimbursed 75% of their tuition costs. If they choose to accept this reimbursement, they must agree to serve an additional service commitment after each paid course. This commitment is three-to-one; for example, for each four month course, part-time officers must serve a twelve month commitment. Part-time students not requesting tuition assistance incur no such commitment. Officers attending AFIT and civilian institutions full-time in pursuit of a master's degree attend their respective schools for approximately 15-24 months, depending on the requirements of the degree

program. Members do not pay tuition for their education, and are partially reimbursed for the cost of books. Military members who attend AFIT or civilian institution graduate programs incur a commitment of 48 months after graduation. This obligation ensures that these personnel are not merely educated and lost to civilian industries. Furthermore, the Air Force ensures it receives a return on its investment by requiring officers receiving AFIT graduate degrees to fill certain advanced academic degree positions in the Air Force (5:2).

Prior Retention Studies. In the past decade, the DOD has sought to model the retention rate of its personnel as a function of changes in various policies (11:10). Most studies have focused on the impact of changes to the retirement system while others have looked at variables such as income levels, bonuses, and entrance requirements. Retention models have been developed for almost every major category of military personnel such as enlisted personnel, rated officers, Air Force officers, and Army personnel, to name but a few. Some studies have focused on specialty codes, which are codes given to the different areas of specialty in the Air Force (i.e., maintenance officer), but few studies have been performed in other specific areas. One area that has received no examination is the retention of AFIT graduates.

Problem Statement

Since there is no information pertaining to the retention of AFIT officer graduates, policy decisions regarding AFIT officer graduates, such as the duration of the commitment for attending an AFIT in-residence program, are being made without the benefit of information specific to the population of AFIT graduates. Certainly one could assume that AFIT expects a majority of its officer graduates to remain in for a period longer than the commitment period. What is not known, however, is how long graduates are actually staying in, and how this compares to

the entire population of Air Force officers. Also unexamined is the manner in which retention varies by the demographic characteristics of graduates and by the type of education (technical or managerial) they received.

Research Objectives

The first objective of this thesis is to provide a demographic and retention summary of a sample of AFIT officer graduates by degree program and year of graduation. The second objective of this thesis is to determine if the retention rates of AFIT officer graduates (identified separately as graduates of specified degree programs in the School of Engineering and graduates of the School of Systems and Logistics) differ significantly from that of Air Force officers as a whole (excluding rated officers and specialists such as medical officers and chaplains). A third objective is to use proportional hazards regression analysis to relate the demographic characteristics of graduates and the type of education they received to their observed retention. This model will then be used to compare the retention between schools, programs, and individuals.

Plan of Thesis

Chapter 2 provides a review of the methods other researchers have used to study retention. Additionally, this chapter describes the methodology used in this research, including the sources and limitations of the data used in the research, as well as how the data are analyzed. Chapter 3 discusses our findings relative to our three research objectives. Finally, Chapter 4 presents a summary of the research findings, conclusions, and recommendations for further study.

II. Literature Review and Methodology

Introduction

This chapter begins with a review of historical approaches to the study of retention issues. Next, the research design of this thesis is discussed, including the data set used and its limitations. This is followed by a discussion of the methodology employed in answering the three research objectives outlined in the previous chapter.

Literature Review

This section presents a review of several approaches researchers have historically taken in analyzing retention issues. The turnover literature focuses on five major types of predictors (or determinants) of turnover: job attitudes, demographics, alternative job opportunities, economic indicators, and behavioral intentions. The term turnover is used more frequently than retention in the literature since turnover implies both retention and attrition.

Job Attitudes. Much of the research in this area focuses on attitudinal variables such as job satisfaction and organizational commitment and their relation to turnover. In their 1973 literature review, Porter and Steers found that overall job satisfaction was inversely related to turnover (17:151). This was a consistent finding in the literature they reviewed, and has been similarly reported in subsequent reviews of this literature. In a study of military officers, Steele used data from the 1985 DOD survey of Officer and Enlisted Personnel and found that job satisfaction had the most influence on career decisions of U.S. Army and Marine Corps officers in their fourth through twelfth year of service (22:1).

In sampling 654 members of the accounting profession, Arnold and Feldman also reported a significant relationship between job satisfaction and actual turnover (1:350). They also found a significant relationship between organizational commitment and turnover. Of course, the relationship between organizational commitment and intent to quit or stay is based heavily on the definition of commitment. Porter, *et al.* include in the definition " a strong desire to remain a part of the organization" (18:91). Such a definition lends itself to a high correlation with turnover.

Demographics. This area of study encompasses such variables as age, race, sex, marital status, and tenure, which are personal characteristics of the individuals under study. Haber *et al.* use information derived from the Current Population Survey (CPS) to test the perception that separation rates of women are higher than men, and that the separation rates of blacks is higher than that for whites. They conclude that higher separation rates for women stem from their greater concentration in low-paying jobs (i.e., below $5 an per hour). At higher wage rates received by the typical male, separation rates are the same for men and women in nearly all cases. Likewise, separation rates for blacks, irrespective of sex, would be lower if there did not exist the wage disparity between blacks and whites. (13:25)

These findings correspond with those of Viscusi. In his 1980 study, Viscusi analyzed 6,000 male and female workers and determined that quit rates due to sex differences have been overstated in previous studies. He states that the primary difference in female quit behavior can be attributed to differences in job characteristics rather than personal behavior. Further, women experience greater quit rates when they have no more than one year of experience. If this variable

were treated as a job characteristic rather than a personal characteristic in Viscusi's model, male and female quit rates would be nearly identical (23:396-397).

Porter and Steers termed demographic variables such as age and tenure as "personal factors". They state the inclusion of such demographic factors plays a central role in developing a comprehensive model of turnover behavior. Their review showed negative relationships between age, tenure, and turnover. Two additional variables also considered as personal factors are family size and family responsibilities. Increased family size was found to be inversely related to turnover among males, while one study found that some turnover could be attributed to spousal pressure alone. (17:164)

Alternative Job Opportunities. Literature in this area concentrates primarily on the relationship between measures of perceived employment alternatives and their ability to predict turnover. Several studies have also explored the connection between the actual job market and turnover.

Gill and Haurin, in an unpublished 1992 study, examined the impact of the spouse on a husband's retention. Using economic and demographic characteristics of a sample of 4,653 military couples, they examined the relationship between a wife's earnings and the retention of married military men. They concluded that the mobility associated with a military career causes a wife's earnings to be reduced. This reduction has a subsequent negative effect on the retention of married men. (9:14)

In their 1989 review and meta-analysis of 23 studies dealing with perceived alternatives and turnover, Steel and Griffeth reported the average corrected correlation between perceived employment alternatives and turnover was .13. Their meta-analysis was a confirmation that many studies attempting to link perceived alternatives with turnover had met with limited success. The researchers

offered potential solutions to what they felt were three methodological problems with these types of studies. These problems are as follows: the use of occupationally homogeneous samples, which can restrict the range of both predictor and criterion variables; failure to consider the effects of the turnover base rate, which can account for up to 36% of the perceived alternatives-turnover correlation; and the inadequacy of standard instruments used to measure perceived alternatives. (21:846-852)

Michaels and Spector suggest that the important role assigned to perceived alternatives in turnover models by many turnover theorists requires a conceptual reexamination. They found that a measure of perceived job opportunities added nothing to Mobley, *et al*'s turnover model. These researchers argue that alternative opportunities may have a more direct effect than hypothesized by the Mobley model. They suggest that the labor market acts directly on a person's behavior rather than on the psychological processes leading up to actually quitting. (15:58)

The General Accounting Office (GAO) was tasked with comparing military and civilian compensation as a function of occupation. Their report was an attempt to analyze how differences between military and civilian compensation have affected the military's ability to retain needed manpower in a small sample of occupations. The GAO was able to match 52 enlisted occupations to their civilian counterparts. However, these matches were against civilian occupations that were computer-related or highly unionized; this resulted in approximately three-quarters of the civilian occupations falling above median pay levels. As a result, the military received less pay than civilians in nearly all comparisons. (7: 1,13)

Economic Indicators. Economic indicators have also been shown to have a moderating effect on perceived alternatives-turnover relationships. The primary economic indicators studied have been national, regional, and occupational

unemployment rates. Carsten and Spector found that during periods of high unemployment (and consequently limited employment opportunities), correlations between -.28 and -.46 were found between unemployment rates and the behavioral intention-turnover relationship (3:377). These results are supported by Steel and Griffeth's 1989 meta-analysis, in which the authors hypothesized that prevailing unemployment rates influence the size of the correlation between perceived alternatives and turnover. In general, the literature they reviewed supported this hypothesis. Additionally, Gerhart, in a 1987 study of young adults, found that regional unemployment rates have both a direct and indirect effect on turnover (8:1990).

Few published studies examine the relationship between general economic conditions and military retention. Grimes, in an unpublished thesis, hypothesized that a relationship would exist between a composite index of 12 leading economic indicators, the number of national help-wanted advertisements, the national unemployment rate, and officer attrition. He found that the overall civilian unemployment rate was a major factor affecting Air Force officer losses, but the inclusion of this predictor variable failed to increase the accuracy of the model currently used by the Air Force to predict losses. (12:i, 27, 45)

Behavioral Intentions. Studies in this area attempt to determine the relationship between an individual's intent to quit, or intent to look for other employment, and turnover. Steel and Ovalle's 1984 meta-analysis indicated that turnover intentions are better predictors of turnover than attitudinal variables such as job satisfaction and organizational commitment (20:682).

The belief that intent is the single best predictor of turnover is implicit in research studying turnover intent (20:673). Kirschenbaum and Weisberg, however, state that care must be taken in indiscriminately using intention in

turnover studies (14:845). They argue that intention is an "attitudinal construct... sensitive to both antecedent and consequent situations, fluctuating in relation to the vagaries of everyday worklife" (14:844). Additionally, they claim that it disregards the influence of other independent variables used in the study. Though the researchers are quick to point out that their limited sample precludes them from categorically making this claim, they conclude that intention and turnover are "distinct constructs which are only superficially linked" (14:830, 845).

Research Design

The nature of our research is both descriptive and causal. First, we present demographics for the two schools, LS (Systems and Logistics) and EN (Engineering), as well as similar information for the programs within the schools. Second, we describe the general nature of AFIT graduate retention, providing AFIT with a snapshot of students graduating between 1973 and 1987. The third part of our research focuses on relationships between certain indicator variables, such as a graduate's Grade Point Average (GPA), and AFIT graduate retention. This thesis does not attempt to consider attitudinal variables such as job satisfaction or organizational commitment. There is no database that exists for AFIT graduates which describes motivations for separating from the Air Force, and it is not within the scope of this research to survey graduates who have already separated. Additionally, this thesis does not attempt to study the relationship of intention to separate to actual separation. Such a relationship has limited applied value with respect to force planning as it is more practical to collect demographic data which is usually more readily available than to regularly collect data on intentions to quit (16:1327).

Description of Population and Sample

Our sample is drawn from the population of all USAF commissioned officer graduates of the AFIT in-residence graduate program. The specific sample from which data is taken includes 5,071 1973 to 1987 graduates. Beginning with the class of 1973 enables the researchers to collect data through twenty years for newly-commissioned second lieutenants as well as all other officers. The sample endpoint was chosen because of the 48-month commitment upon graduation. 191 (4%) of the graduates are female, 1,293 (27%) have an aeronautical rating, and 1,077 (21%) have prior time as an enlisted member. The average age at graduation of this sample is 30.1 years. March 1992 is the most recent period that separation data was gathered for this research. Officers graduating in 1987 or prior have all had the opportunity to voluntarily separate from the Air Force by this point in time. Officers from allied countries and other services, as well as civilians, were excluded from the sample.

Data Collection

Master Roster of AFIT Graduates. The AFIT Registrar's office (AFIT/RR) provided a database of all in-residence graduates. Pertinent information in this database includes name, social security number (SSN), and the program from which each officer graduated.

Demographic Variables. GPAs for each graduate from 1976 to 1987 were obtained from files located in AFIT/RR. All other information for these graduates was provided by the Defense Manpower Data Center (DMDC). Working from the master roster, DMDC was able to provide a "matched-member file"; that is, for each proper SSN provided, DMDC searched through two USAF officer databases until a match was obtained. The "loss" file contains information on officers who have already separated from the Air Force. Similarly, the "current" file

is a database of USAF officers still on active duty. DMDC searched both databases to provide the requested information.

USAF Officer Retention Rates. The USAF Military Personnel Center (AF MPC) provided retention rates, by years of commissioned service, for the periods 1981 to 1991 for USAF officers classified as mission support. This category of officers includes all non-rated officers except chaplains and medical officers. Officers in flight training are included in this category until they receive their aeronautical rating (2). Our sample of AFIT graduates contained a significant percentage of rated officers. Though AF MPC also records separate retention rates for rated officers, we assume that the retention rates of rated officers who will not go back into the cockpit (such as those who attend AFIT) will more closely approximate those of mission support officers than those of rated officers in flying status. Therefore, the mission support retention rates were used in this analysis.

Each year's information includes the total population at the end of the fiscal year and losses during that year, reported by years of commissioned service (one through thirty). AF MPC calculates yearly retention rates by dividing the losses during the year in a specific year group by the total population for that year group. Statistical analysis shows that there is no significant difference between the means of each year group's retention rate over the eleven year period. Consequently, overall retention rate means were computed and used to compare against AFIT graduate retention rates.

Data Limitations/Assumptions. Several sources of potential data error were found in collecting our data. First, the master roster of graduates contains many errors; for instance, some graduates were omitted. This master roster is used as the basis for our data collection, providing a skeleton for the complete database. Some files of graduates listed in the roster were missing. In addition,

several graduate folders were checked out. These file folders contain information on all of the students who have attended AFIT. AFIT/RR keeps records of information such as undergraduate transcripts, GRE/GMAT test scores, application papers, graduate transcripts, and documentation relating to academic deficiencies. The absence of these folders resulted in missing GPA values for approximately 25 graduates. Second, a small number of graduates (approximately 30) could not be matched by DMDC. As a result, these individuals had only program name, year of graduation, and GPA associated with them. Third, fifteen graduates had in their DMDC records dates of separation that were earlier than their dates of commissioning. The records were kept, though they had no time-series data associated with them. Finally, 88 of the files of 1976 to 1987 graduates had no indication of whether or not the officer actually graduated. In most instances, the officer did not finish his thesis, receiving an incomplete, or a failing grade. All of these officers are considered to be nongraduates and were deleted from the sample.

Two assumptions were made to complete the database. Unless otherwise noted in an individual's file, each officer was assumed to have graduated on time with the rest of his class. Also, graduates are considered to have prior service (i.e., time in enlisted service) if the difference between their commissioned service date and their total military service date is greater than one year. This criteria is based on the fact that it is possible for an ROTC graduate to wait up to a year before coming onto active duty. In addition, it's rare for a service member to serve less than one year of enlisted time, making this cutoff a reasonable figure.

Database of 1973 - 1986 Graduates

The complete database included records for 5,071 graduates. A small percentage of the records contained missing data for one or more of the variables.

This has little impact on regression analysis, but did affect the reporting of descriptive statistics. All of the information is covered by the Privacy Act of 1974; names were retained in the database to ensure the files were merged properly by Social Security Number.

Variables Collected. The following variables, in addition to SEX (male=0, female=1), were either collected in the AFIT Registrar's office or provided by DMDC:

GPA: Graduate Grade Point Average, graded on a four-point scale.

PGMGROUP: Program group from which the officer graduated. The program codes given by AFIT are used in this research. This is a three letter code such as GSM, which stands for the Graduate Systems Management program. The grouping of programs is discussed later in this chapter.

ENSCHOOL: Identifies the school a graduate attended. The School of Engineering is designated by 1, the School of Systems and Logistics by 0.

TAFMSD: Total Active Federal Military Service Date, the date on which the service member entered active duty in the armed forces.

TAFCSD: Total Active Federal Commissioned Service Date, the date on which the service member became a commissioned officer either through Officer Training School (OTS), Reserve Officer Training Corps (ROTC), or a service academy.

RATED: Aeronautical rating, indicates whether an officer is (1) or is not (0) rated. This does not signify that an officer is currently on flying status, but rather that he or she has at one time been on flying status and now continues to be identified as a rated officer.

GRADDATE: Graduation Date , the year and month of graduation. These dates were not explicitly available; instead, this data was obtained from the initial

program identifier in the master roster, before the programs were grouped into PGMGROUP. An example is GSM-87S, which signifies a September (S) 1987 graduate from the Graduate Systems Management Program.

DOS: Date of separation from active duty.

RACE: As provided by DMDC, this includes one of six ethnic groups – unknown (0), white (1), black (2), Hispanic (3), American Indian/Alaskan Native (4), Asian/Pacific Islander (5), and other (6). In our regression analysis, however, black =1 and other=0.

Variables Calculated.

PRIOR: Signifies whether a graduate did (1) or did not (0) spend time as an enlisted member prior to becoming a commissioned officer. An officer was given prior status if TAFMSD was at least one year earlier than TAFCSD.

LOSAFIT: Length Of Service after AFIT, reported in years. For purposes of reporting descriptive statistics, this is calculated by subtracting GRADDATE from DOS; graduates still on active duty as of March 1992 do not have a DOS, and do not have a value for LOSAFIT.

TIMEIN: The total length of service for officers still in the Air Force up to March 1992, reported in years.

LOSTOTAL: Total Length Of Service. For officers who are no longer on active duty, this equals DOS minus TAFMSD. Officers still in the Air Force are not assigned a value for this variable.

TOTAFIT: Total military service time prior to beginning the AFIT program. It equals GRADDATE minus the duration of the specific program minus TAFMSD.

GRADAGE: Age at graduation. Calculated using the birthdates provided by DMDC.

Statistical Procedures

A spreadsheet program was used to enter in GPAs and also to create the various graphs and tables presented in this thesis. Two-sample t-tests were computed using STATISTIX©. The SAS® program resident on AFIT's VAX was used for the majority of the statistical work for this study: merging the various databases, performing the regression analysis, and providing summary descriptive statistics.

Program Grouping. Over the past twenty years, several AFIT programs have been dropped, while other new programs have been added. For instance, a separate track for Contract Management, GCM, was first offered in 1982. In addition, some programs were merged into others. For this reason, the programs were put into program groups: eleven for the School of Engineering, and four for the School of Systems and Logistics. The specific grouping scheme for each program is discussed in further detail in Chapter 3. Only those programs that graduated classes in 1987 and are still currently offered by AFIT will be included in this research. As a result, some programs have as much as 15 years of data, while others have as little as five years. The acronyms used for each program group, in addition to the many other acronyms presented in our study, are compiled in a glossary of acronyms in Appendix A.

Descriptive Research

Demographics. The first objective of our thesis is to summarize the demographics for each class since 1973. This is not only for informational purposes, but also to determine if there are trends that exist with respect to GPAs, percent of the class that are rated officers, years of service before entrance into AFIT, etc. The demographics of each program group, reported by year of graduation and summarized in tables, are presented in the next chapter.

Retention Rates. The second objective of our research is to compare the actual retention rates of AFIT graduates to the retention rates of otherwise similar Air Force officers. Losses are identified for each year after graduation for each program across the period 1973 to March 1992. These figures are then used to calculate the actual retention rates for each program group and school.

Retention rates provided by AF MPC serve as the basis for calculating the retention rates of otherwise similar Air Force officers. In essence, we assign each graduate a retention rate for each year after graduation that is representative of similar officers in the Air Force at large. This information is presented graphically by years after graduation.

T-tests. Two-sample t-tests are conducted to compare actual retention rates versus expected retention rates. The null hypothesis tested is that there is no difference between the means of the two rates. P-values, which represent the smallest level of significance at which this null hypothesis would be rejected, are determined for each test (6:315).

Proportional Hazards Regression Analysis. The analysis of retention is complicated by the fact that a large number of individuals in our sample have not yet separated and therefore we do not know the amount of service time they will have when they ultimately leave the military. Normal multiple regression procedures cannot model retention behavior and still take into account information on graduates currently in the Air Force. We overcome this shortcoming by using proportional hazards regression (proportional in this case means that the hazard ratio does not change with time). PHREG (Proportional Hazards REGression) is a SAS® procedure used to analyze survival or "lifetime" data (19). This "lifetime" data is composed of members of a population who, through the life of the experiment, experience different types of treatments. The experiment is then

stopped at a specified time and those who are not present, because of separation from the service in this case, have *event* times associated with them. Those who "survive" until the end of the experiment or drop out of the experiment because of reasons unrelated to the behavior under study, have censored times associated with them. Those members who have separated from the Air Force can be considered as "mortalities" of the sample and their separation times are the event times. Those who are still on active duty service as of March 1992 are, in a sense, "still alive" at the end of the experiment and the observations of their times in service after graduation from AFIT through March 1992 are censored. These members of the sample have their "survival" times censored because it is impossible to know the amount of time that would actually elapse between the end of the experiment and their eventual separation. The retirees in our sample also have their times censored because we choose to study voluntary separations and some of these retirees (we do not know whom) were forced to retire because they reached a mandatory retirement point given their rank and time in service. The PHREG proportional hazards regression procedure also plots the survival curves for the sample under study. The resulting plot reveals an estimated survival curve over time that accounts for the characteristics of the sample.

III. Analysis and Discussion of Results

Introduction

Following the methodology outlined in the previous chapter, descriptive statistics are first presented for each school and program group. Next, a retention analysis is performed on each school, the School of Engineering (EN) and the School of Systems and Logistics (LS), and also on the program groups within each of these schools. Actual retention rates for each school and program group are compared to each other. Additionally, the actual rates for each school are compared to the rates of otherwise similar officers in the Air Force at large. The final section of this chapter presents the results of the proportional hazards regression (PHREG) model. The PHREG model is used to construct survival curves for each school and also to conduct sensitivity analyses using varying GPAs and graduation ages for graduates within each school. The reader should keep in mind that the comparison of actual and expected retention rates in the first part of this chapter does not control for all the possible sources of variance; this method, however, is the only means available to compare the retention of AFIT graduates to the Air Force at large. On the other hand, the PHREG procedure controls for many of these sources of variance, but this method can only be used for comparing one AFIT school or program group versus another.

Descriptive Statistics for Schools and Program Groups

School of Engineering. The School of Engineering (EN), in its present form, was established in 1946 as the College for Engineering and Maintenance (4:2). It later became the College of Engineering Sciences. In 1954, Congress gave the AFIT Residence College, as AFIT was then known, authority to confer

degrees (4:2). Just a few years later, the college was divided into the School of Engineering, the School of Logistics, and the School of Business (4:2). The School of Engineering is organized into the academic departments of Aeronautics and Astronautics, Electrical and Computer Engineering, Mathematics and Computer Science, Operational Sciences, and Engineering Physics (4:35).

According to the AFIT Catalog, the purpose of the School of Engineering is to "Provide scientific and technological education in an Air Force research and development environment" (4:33). Additionally, the school is responsible for "the technical education of USAF officers so they can fulfill to a greater degree their obligation of service to their country" (4:33). Table 1 provides a summary of the demographics of the 1973-1987 EN graduating classes. Reading the table from left to right shows that the average class size is 193 graduates, with approximately 60% of these graduates still in the service. On average, each class includes 3% female officers, 28% rated officers, with 19% of the officers having prior enlisted time. From 1976 to 1987, the average GPA for EN graduating classes is 3.51. The average age at graduation for EN graduates is just over 29 years. The average service time before beginning AFIT is six years and the average EN graduate has served two years as a Captain before attending AFIT.

The School of Engineering currently has eleven Masters' degree-granting programs. In addition to these eleven programs, EN has, over the course of the fifteen years sampled, offered several other programs. To more concisely summarize the results of our analysis, similar programs have been grouped together where appropriate. Eleven such program groups exist for EN. For consistency, programs that are not grouped in this fashion (i.e., the Graduate Operations Research program) are also referred to as program groups, though they are in actuality distinct programs.

TABLE 1. DESCRIPTIVE STATISTICS FOR THE SCHOOL OF ENGINEERING

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	237	10	0	35	25	.	30.0	7.3
74	214	19	0	32	25	.	30.1	7.2
75	178	21	0	35	17	.	30.5	7.3
76	137	29	0	57	17	3.56	30.9	7.5
77	129	36	1	57	11	3.50	30.2	6.7
78	191	53	2	28	11	3.46	28.5	5.0
79	149	63	1	21	16	3.48	28.5	5.1
80	143	74	4	31	21	3.49	28.3	4.9
81	194	66	2	21	26	3.50	28.5	5.2
82	243	68	5	24	16	3.49	28.9	5.2
83	231	65	4	24	24	3.52	29.4	6.1
84	224	75	6	25	17	3.50	28.8	5.4
85	224	79	6	24	19	3.53	29.6	6.3
86	227	83	8	21	19	3.55	29.0	5.5
87	227	93	4	19	26	3.57	29.5	6.0
MEAN	197	57	3	29	20	3.51	29.3	6.0

Graduate Astronautical Engineering (GA) Program Group. The Astronautical Engineering program is designed to not only prepare officers to be engineers in the astronautical engineering field, but to also assist them in evaluating, monitoring, and administering astronautical R&D projects (4:45). This program group, like nearly all EN programs, is 18 months long. Table 2 presents a summary of the descriptive statistics of the 1973 to 1987 GA graduates. The class size is generally small, averaging only 14 students per year.

Graduate Aeronautical Engineering (GAE) Program Group. This 18-month program provides students with a broad theoretical background, and considerable specialization, in the various areas of aeronautical engineering (4:43). Merged into this program group are two small, short-lived graduate programs: Air Weapons (GAW), offered until 1974, and Aerospace and Mechanics (GAM), offered until 1975. Table 3 presents a profile of the fifteen graduating classes of

TABLE 2. DESCRIPTIVE STATISTICS FOR GA

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	31	16	0	42	23	.	30.5	7.7
74	16	38	0	50	19	.	29.9	6.7
75	7	29	0	71	0	.	29.7	6.1
76	16	25	0	75	13	3.53	29.4	6.1
77	16	44	0	75	0	3.51	29.7	6.1
78	14	50	7	7	0	3.43	26.8	3.3
79	12	58	8	42	17	3.48	29.6	5.8
80	8	75	0	13	25	3.47	25.9	2.7
81	11	82	9	0	0	3.60	24.5	1.7
82	10	60	0	30	0	3.57	27.4	4.3
83	11	100	9	27	45	3.52	29.2	6.4
84	17	76	0	29	12	3.38	29.1	4.7
85	14	79	0	14	36	3.43	29.9	7.6
86	13	92	0	38	23	3.48	29.2	6.6
87	9	100	11	22	0	3.61	28.1	4.4
MEAN	14	56	2	40	15	3.49	28.9	5.7

interest. The average class size has decreased considerably since 1974's graduating class. This program group also has a large number of officers with prior enlisted service– 42%, compared with the school average of 19%.

TABLE 3. DESCRIPTIVE STATISTICS FOR GAE

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	67	16	0	39	19	.	30.4	7.7
74	58	19	0	40	14	.	30.1	6.9
75	33	21	0	55	9	.	29.9	6.4
76	19	21	0	68	21	3.53	30.7	7.0
77	25	36	0	72	8	3.48	30.3	6.9
78	17	65	0	59	0	3.25	27.2	3.2
79	20	75	0	20	15	3.39	28.3	4.6
80	23	83	0	48	4	3.49	28.1	4.6
81	28	82	4	32	14	3.32	27.5	4.8
82	32	72	3	41	9	3.40	28.5	5.1
83	32	75	9	34	13	3.41	28.1	4.9
84	25	76	8	32	12	3.29	28.0	4.9
85	26	85	8	19	8	3.35	28.3	4.7
86	24	83	8	21	17	3.46	28.7	5.2
87	22	95	9	14	14	3.39	28.2	4.3
MEAN	30	53	3	42	13	3.40	28.8	5.4

Graduate Computer Systems (GCS) Program Group. For this research, the GCS program group includes another smaller, similar program: Computer Engineering (GCE), which graduated classes in 1974-1976, and 1986-1987. This program group prepares graduates for future assignments designing, testing, evaluating, and/or managing computer hardware or software systems (4:47). The demographics for this program group, as shown in Table 4, are similar to those of EN as a whole, with the exception of the percentage of rated officers, which is half the EN average. Additionally, the average GPA for the program is 3.63, much higher than the EN average.

TABLE 4. DESCRIPTIVE STATISTICS FOR GCS

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
74	7	29	0	0	0	.	30.1	7.0
75	7	14	0	57	0	.	32.5	9.1
76	12	33	0	67	0	3.56	30.8	6.8
77	14	36	7	50	0	3.68	28.2	4.8
78	21	38	5	14	29	3.61	30.1	6.4
79	16	69	0	13	25	3.73	29.1	5.7
80	12	67	17	8	25	3.55	28.1	4.6
81	23	57	9	4	30	3.63	29.0	5.6
82	38	55	11	5	21	3.64	29.5	5.4
83	32	78	3	9	25	3.52	29.2	5.8
84	25	68	12	8	20	3.62	27.6	4.4
85	26	69	8	12	31	3.70	30.8	7.0
86	39	69	18	8	18	3.64	28.6	4.6
87	35	94	0	9	40	3.64	30.0	6.7
MEAN	22	63	8	14	23	3.63	29.4	5.8

Graduate Electrical Engineering (GE) Program Group. Graduates of this program are expected to have demonstrated fundamental competence in those areas of electrical engineering which are of particular emphasis to the Air Force (4:52). Students complete at least two of approximately ten sequences that include Electronic Warfare and Communications/Radar. This program group includes graduates of the Guidance and Control (GGC) program, which was offered until 1974. As shown in Table 5, this is by far the largest program offered by EN, graduating nearly 25% of the school's officers each year. Perhaps because of its size, GE's demographics closely match those of the school as a whole, with the exception of reversed figures for rated and prior percentages..

TABLE 5. DESCRIPTIVE STATISTICS FOR GE

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	86	2	0	14	36	.	29.2	6.8
74	74	14	0	12	42	.	29.9	7.3
75	57	21	0	28	26	.	30.6	7.6
76	37	16	0	30	35	3.59	31.6	8.6
77	41	29	0	44	22	3.46	31.5	8.2
78	54	52	0	19	17	3.52	29.1	5.8
79	41	59	2	7	20	3.45	27.2	3.9
80	38	68	5	13	34	3.48	28.4	5.5
81	48	50	0	13	52	3.46	29.3	6.3
82	55	71	5	18	25	3.47	28.5	4.9
83	63	54	5	13	38	3.53	28.8	5.8
84	65	69	5	12	32	3.50	28.8	5.5
85	59	71	3	15	29	3.57	29.3	6.2
86	65	80	5	5	32	3.53	28.5	5.0
87	64	89	2	9	42	3.56	29.6	6.3
MEAN	56	49	2	17	33	3.51	29.3	6.2

Graduate Electro-Optics (GEO) Program Group. First offered in 1975, GEO is under the joint supervision of the Departments of Engineering Physics and Electrical Engineering. The program provides graduates with a knowledge of optics and laser technology necessary for work in this field (4:57). The descriptive statistics for GEO are shown in Table 6. One statistic of note is the percentage of graduates still in the service. Nearly 68% are still in, compared to 60% for the School of Engineering. One possible explanation for the high percentage still in the service is the fact that they have access to some of the finest laser and optical resources in the world at Air Force laboratories.

TABLE 6. DESCRIPTIVE STATISTICS FOR GEO

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
76	5	0	0	60	40	3.46	34.8	11.6
77	10	80	0	20	10	3.48	26.8	3.0
78	7	71	0	43	100	3.44	25.4	2.2
79	7	57	0	0	29	3.20	27.6	4.3
80	13	77	0	23	38	3.32	27.2	4.2
81	10	80	0	20	40	3.37	27.4	4.0
82	15	80	7	13	7	3.42	26.2	2.8
83	11	36	0	9	18	3.52	26.6	3.0
84	8	63	0	13	38	3.44	29.3	6.1
85	2	100	0	50	0	3.52	31.5	9.1
87	10	90	20	20	50	3.59	28.5	5.2
MEAN	9	68	3	19	27	3.43	27.6	4.2

Graduate Engineering Physics (GEP) Program Group This program is intended to provide a strong foundation in applied physics with specialization in the physics of one of several areas, including electromagnetics (4:58). Table 7 presents a summary of the demographics of each graduating class of GEP graduates. On the average, GEP students enter AFIT with over one year less of service than the average EN graduate.

Graduate Nuclear Engineering (GNE) Program Group. This program prepares officers for assignments involving the vulnerability and survivability of DOD weapon systems as well as positions involving nuclear detection, testing research, and production (4:59). As reflected in Table 8, this program group did not graduate any officers in 1977. Also, the first year that this program group graduated female officers was 1985.

TABLE 7. DESCRIPTIVE STATISTICS FOR GEP

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	20	5	0	35	10	.	30.3	6.8
74	12	8	0	25	8	.	30.0	5.6
75	17	18	0	18	12	.	29.2	5.5
76	13	38	0	54	8	3.56	30.6	7.3
77	14	14	0	43	14	3.48	31.3	8.0
78	21	43	5	29	10	3.38	28.5	5.2
79	15	80	0	13	7	3.33	26.3	2.6
80	9	78	0	22	0	3.40	25.3	2.0
81	11	64	0	73	0	3.52	26.5	2.8
82	25	68	8	28	16	3.34	29.0	4.5
83	13	69	0	15	23	3.32	29.2	5.2
84	14	79	7	29	7	3.42	27.9	4.6
85	9	89	0	0	0	3.39	25.3	1.7
86	11	100	0	0	0	3.52	26.4	3.0
87	10	100	0	10	10	3.51	27.9	4.3
MEAN	14	53	2	25	9	3.42	28.5	4.8

TABLE 8. DESCRIPTIVE STATISTICS FOR GNE

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	5	40	0	60	0	.	30.8	7.3
74	10	20	0	10	20	.	29.0	5.8
75	20	20	0	25	5	.	30.9	7.6
76	7	14	0	57	14	3.43	30.7	6.1
78	23	61	0	35	0	3.40	27.7	4.5
79	1	100	0	0	0	3.46	31.0	9.1
80	3	100	0	33	33	3.45	28.3	6.1
81	10	80	0	20	20	3.57	29.0	5.5
82	9	78	0	22	11	3.51	28.9	5.4
83	7	29	0	14	29	3.32	28.7	6.1
84	9	78	0	0	0	3.50	24.8	1.4
85	16	75	13	31	0	3.44	28.3	4.9
86	9	89	11	33	44	3.48	29.2	5.8
87	5	100	20	20	0	3.48	29.2	5.5
MEAN	10	57	3	28	10	3.45	28.8	5.4

Graduate Operations Research (GOR) Program Group. Previously titled Graduate Systems Analysis (GSA), the GOR program provides a background in mathematics, economic analysis, operations research, and related disciplines; emphasis is on relating quantitative analysis into the Air Force's decision-making framework (4:61). Table 9 shows that the demographics of GOR are similar to those of the entire school, with the only significant difference being a slightly higher average GPA.

TABLE 9. DESCRIPTIVE STATISTICS FOR GOR

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	15	7	0	60	13	.	31.5	8.3
74	28	25	0	32	18	.	30.5	7.9
75	18	17	0	22	33	.	30.7	7.9
76	18	44	0	67	0	3.60	30.7	7.6
77	9	33	0	78	0	3.58	29.6	5.8
78	17	53	6	29	6	3.59	29.7	5.9
79	14	71	0	36	14	3.68	29.2	6.1
80	13	85	8	31	23	3.64	29.9	5.9
81	17	53	0	12	0	3.68	25.9	2.5
82	16	81	6	19	19	3.54	28.6	4.9
83	18	67	6	11	17	3.58	29.1	5.9
84	17	71	24	18	0	3.50	27.7	4.3
85	21	81	10	24	5	3.48	29.0	5.5
86	20	90	15	10	10	3.61	28.1	4.6
87	20	85	5	20	10	3.63	28.2	4.7
MEAN	17	58	5	31	12	3.59	29.2	5.9

Graduate Systems Engineering (GSE) Program Group. Systems Engineering is defined by the AFIT Catalog to be "the application of scientific and engineering knowledge to the planning, design, and analysis of man-machine systems and their associated components" (4:64). This program is unique in that

the thesis is not an individual effort, but rather involves up to ten students working in a design team for a nine month period (4:65). Table 10 provides summary statistics for this program for the classes of 1973 to 1987, with the exception of 1977 and 1984, when this program did not graduate any officers. During this 15 year period, GSE did not graduate any female officers. Otherwise, the program demographics closely approximate those of the school.

TABLE 10. DESCRIPTIVE STATISTICS FOR GSE

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	13	8	0	31	31	.	29.1	7.3
74	9	11	0	56	44	.	33.7	11.2
75	18	22	0	17	22	.	31.5	8.5
76	8	63	0	50	0	3.73	30.3	5.7
78	16	63	0	31	13	3.35	27.8	4.8
79	8	88	0	13	13	3.53	28.0	5.7
80	8	75	0	13	13	3.40	27.5	3.4
81	15	73	0	7	40	3.48	28.6	6.1
82	6	83	0	33	0	3.44	28.3	4.6
83	6	67	0	33	17	3.53	30.8	7.6
85	6	100	0	17	33	3.35	28.7	5.6
86	5	100	0	40	0	3.51	29.2	6.7
87	13	100	0	38	23	3.72	29.0	6.1
MEAN	10	60	0	29	21	3.51	29.4	6.4

Graduate Space Operations (GSO) Program Group. This program provides its graduates with a broad interdisciplinary background so that they may apply scientific management techniques to the accomplishment of the full spectrum of space missions (4:63). As Table 11 shows, only six years of data are available for the GSO program within our sampled years. Consequently, the program has a higher percentage of graduates still in. Graduates are nearly 1 1/2 years older

TABLE 11. DESCRIPTIVE STATISTICS FOR GSO

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
82	14	64	0	0	21	3.49	29.8	6.1
83	19	63	0	42	0	3.68	32.1	8.5
84	24	83	4	42	8	3.63	30.1	7.1
85	21	76	14	43	29	3.59	30.9	7.4
86	36	47	3	19	0	3.53	29.4	6.6
87	20	95	0	30	25	3.58	31.0	7.3
MEAN	22	80	4	33	13	3.59	30.6	7.0

than the average EN graduate, with nearly one more year of service before entering AFIT.

Graduate Strategic and Tactical Sciences (GST) Program Group. This program first graduated students in 1979. This program merges military operations, quantitative sciences, and weapon engineering and applies these to the "art of war" (4:62). As one might expect of a program of this nature, a significant percentage of the graduates are rated, more than double the school average. This is shown in Table 12. This large proportion of rated officers most likely accounts for the relatively high value of 8.9 years of service before attending AFIT, and similarly the higher age at graduation.

TABLE 12. DESCRIPTIVE STATISTICS FOR GST

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
79	15	20	0	47	7	3.43	33.3	9.7
80	16	63	0	69	6	3.62	30.6	7.2
81	20	70	0	60	10	3.51	32.8	9.3
82	23	57	0	61	4	3.56	31.8	8.2
83	19	68	0	74	16	3.64	33.1	9.8
84	20	90	0	70	10	3.68	32.2	8.5
85	18	89	0	78	0	3.57	32.2	8.8
86	22	91	0	77	5	3.55	32.7	9.4
87	19	100	0	63	0	3.51	32.0	8.7
MEAN	19	73	0	69	6	3.57	32.3	8.9

School of Systems and Logistics. The School of Systems and Logistics (LS) began as the College of Logistics and Procurement in 1946. Later designated the College of Industrial Administration, it wasn't until 1955 that AFIT established a formal logistics education program. Three years later in 1958, the School of Logistics became a permanent part of AFIT; it was in 1963 that it took its current name. (4:2)

The School of Systems and Logistics is the "Air Force's graduate school of technical management" (4:158). LS has a three-fold mission, the primary element of which is meeting the Air Force's educational needs. The second element of its mission is research, and the third is consulting (4:178). The school is organized into the six departments of logistics management, systems acquisition management, communications and organizational sciences, quantitative management, contracting management, and government contract law (4:157).

For purposes of this research, LS is divided into four program groups, which are explained in detail later in this chapter. Each program is 15 months, except for the Graduate Information Resource Management (GIR) program that

began in 1987 and lasts 18 months. Since this program is not similar to any other LS programs, it is not grouped into a program group. Demographics for GIR are not separately reported since only one class exists in the sample. However, data from this program is included in the overall LS descriptive statistics. The Graduate Engineering Management (GEM) program graduated students beginning in 1981. Since GEM was a part of LS during the years sampled, descriptive statistics for the program are included in the overall LS statistics. However, the program has since moved to the School of Civil Engineering and Services and is not separately reported as an LS program in our study.

Table 13 provides a summary of the descriptive statistics for this school for the 1973 through 1987 classes. As compared to EN graduates, LS graduates arrive with nearly two more years of service and subsequently are nearly two years older at graduation. A reason for this may be that EN programs build heavily on undergraduate education; therefore, a more recent undergraduate degree is preferable and will serve to help EN students more easily get through their program. In addition, engineering fields of study change more rapidly and officers may feel that they need to apply their undergraduate knowledge before their education becomes outdated. Finally, with respect to class size, LS graduates approximately fifty fewer officers per year.

Graduate Cost Analysis (GCA) Program Group. This program previously was an option under the Graduate Systems Management Program. With the addition of several cost analysis-specific courses to the program, it became a distinct program in 1983. The program stresses the concepts of cost modeling and estimating and the correct application of quantitative techniques used in cost analysis (4:191). Table 14 presents descriptive statistics for the program group.

TABLE 13. DESCRIPTIVE STATISTICS FOR THE SCHOOL OF SYSTEMS AND LOGISTICS

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	131	13	0	30	26	.	32.0	9.4
74	152	22	0	22	19	.	32.0	8.8
75	168	20	1	23	21	.	32.6	9.2
76	180	24	0	38	14	3.57	31.7	8.3
77	159	38	1	38	16	3.57	31.2	8.1
78	141	47	1	25	23	3.62	30.8	7.5
79	118	64	0	35	18	3.60	31.5	8.4
80	121	65	6	27	20	3.56	30.2	7.2
81	121	71	7	24	31	3.56	30.0	6.9
82	130	79	7	15	32	3.62	30.1	6.9
83	139	76	6	22	28	3.58	30.7	7.0
84	151	83	11	27	23	3.68	30.7	6.8
85	146	82	10	18	27	3.65	30.8	7.1
86	128	88	15	13	27	3.64	31.5	7.8
87	127	90	11	9	32	3.64	30.9	7.3
MEAN	141	56	5	25	23	3.61	31.1	7.8

TABLE 14. DESCRIPTIVE STATISTICS FOR GCA

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
83	10	40	10	20	0	3.58	27.7	4.9
84	9	89	0	56	11	3.68	29.7	6.4
85	9	78	0	11	33	3.62	28.6	5.4
86	10	100	40	0	40	3.59	31.9	8.8
87	10	90	30	0	40	3.50	31.7	8.2
MEAN	10	79	17	17	25	3.59	29.9	6.7

GCA graduates, at less that 30 years of age, are the youngest of the LS school at graduation.

Graduate Contract Management (GCM) Program Group. The GCM program was previously an option of the Graduate Logistics Management Program. The program is intended to provide students with the knowledge and skills to manage human, financial, and contractual resources in the contracting career field (4:170). As shown in Table 15, the GCM program group consists of 33% prior service officers, ten percent more than the school.

TABLE 15. DESCRIPTIVE STATISTICS FOR GCM

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
83	11	91	0	36	36	3.70	31.0	8.9
84	13	100	31	38	31	3.64	31.5	6.3
85	16	69	6	0	44	3.55	30.1	6.8
86	16	75	38	6	25	3.68	31.6	6.7
87	10	90	0	0	30	3.66	28.7	5.5
MEAN	13	83	17	15	33	3.64	30.7	6.8

Graduate Logistics Management (GLM) Program Group. This program group is the largest in LS and encompasses the following programs: Acquisition Logistics (GAL); Inventory Management (GIM); Logistics Management (GLM); Maintenance Management (GMM); Transportation Management (GTM); International Logistics Management (GIL), which was offered from 1979-1983; GCM before it became its own program; Procurement Management (GPM), which was offered from 1974-1978; Facilities Management (GFM), which was offered from 1974-1980; and Logistics (LOG), which previously contained GAL, GIM, GLM, GMM, and GTM. Though the latter have since become separate programs, we believe they remain similar to the extent that this similarity warrants keeping them in the GLM program group. As Table 16 shows, GLM accounts for nearly

two-thirds of LS graduates each year because of the many programs contained in this program group. Also, graduates of this program appear to be the most experienced when arriving at AFIT.

TABLE 16. DESCRIPTIVE STATISTICS FOR GLM

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	102	13	0	23	28	.	31.8	9.5
74	121	21	0	13	20	.	32.2	9.0
75	138	22	1	16	26	.	32.8	9.4
76	142	26	0	32	16	3.59	32.0	8.6
77	129	36	2	31	19	3.59	31.5	8.3
78	115	43	1	23	22	3.64	31.1	7.8
79	78	67	0	29	19	3.61	31.4	8.5
80	90	62	4	29	20	3.53	30.2	7.4
81	62	79	10	11	42	3.51	30.2	7.4
82	67	84	12	15	43	3.60	31.0	7.9
83	66	83	9	20	35	3.54	31.2	7.2
84	68	84	13	19	31	3.68	31.4	7.3
85	72	90	8	24	31	3.68	32.4	8.4
86	66	89	11	15	33	3.65	32.2	8.7
87	56	93	13	18	32	3.61	32.2	8.5
MEAN	91	51	4	23	26	3.60	31.7	8.3

Graduate Systems Management (GSM) Program Group. Once a part of the School of Engineering, the GSM program is designed to give officers with a technical background the management education necessary to manage "a variety of research, engineering, and development systems and related activities" (4:172). Table 17 provides descriptive statistics of the program's graduates from 1973 to 1987. The GSM program group has the same percentage of graduates still in the service and the same percentage of female officers as LS.

TABLE 17. DESCRIPTIVE STATISTICS FOR GSM

GRAD YEAR	NUM GRAD	% IN NOW	% FEM	% RATED	% PRIOR	GRAD GPA	AGE AT GRAD	YRS SVC PRE AFIT
73	29	14	0	48	17	.	32.4	9.7
74	30	20	0	50	17	.	31.0	8.5
75	30	13	0	48	0	.	31.7	8.0
76	38	18	0	49	5	3.48	30.6	7.2
77	30	50	0	53	7	3.50	30.0	6.8
78	25	60	0	30	28	3.52	29.4	6.4
79	40	58	0	46	15	3.69	31.7	8.6
80	31	71	10	19	19	3.63	30.4	7.1
81	37	76	5	41	22	3.62	30.1	7.0
82	39	62	3	20	21	3.60	29.7	6.2
83	26	58	4	23	27	3.61	31.2	7.7
84	36	72	8	31	8	3.69	29.8	6.0
85	25	76	28	16	8	3.59	29.2	5.2
86	12	75	8	17	17	3.83	30.0	6.4
87	20	85	15	5	20	3.73	29.6	6.0
MEAN	30	56	5	35	14	3.61	30.5	7.2

Summary Statistics for GPA , LOSAFIT, and LOSTOTAL for EN and LS

Tables 18 and 19 show GPAs for the program groups within EN and LS, respectively. The average GPA for EN graduates is 3.51. The range of GPAs within the program groups is from 3.40 for GAE to 3.63 for GCS. This is in contrast with the 3.61 average for LS students, with a range between 3.59 for GCA and 3.64 for GCM. There is greater variability between the GPAs of EN program groups than LS program groups. Between the fifteen years, however, each school's GPA varies by as much as .11.

TABLE 18. SUMMARY OF GPAS FOR EN PROGRAM GROUPS

GRAD YEAR	EN	PROGRAM GROUP GA	GAE	GCS	GE	GEO	GEP	GNE	GOR	GSE	GSO	GST
76	3.56	3.53	3.53	3.56	3.59	3.46	3.56	3.43	3.60	3.73	.	.
77	3.50	3.51	3.48	3.68	3.46	3.48	3.48	.	3.58	.	.	.
78	3.46	3.43	3.25	3.61	3.52	3.44	3.38	3.40	3.59	3.35	.	.
79	3.48	3.48	3.39	3.73	3.45	3.20	3.33	3.46	3.68	3.53	.	3.43
80	3.49	3.47	3.49	3.55	3.48	3.32	3.40	3.45	3.64	3.40	.	3.62
81	3.50	3.60	3.32	3.63	3.46	3.37	3.52	3.57	3.68	3.48	.	3.51
82	3.49	3.57	3.40	3.64	3.47	3.42	3.34	3.51	3.54	3.44	3.49	3.56
83	3.52	3.52	3.41	3.52	3.53	3.52	3.32	3.32	3.58	3.53	3.68	3.64
84	3.50	3.38	3.29	3.62	3.50	3.44	3.42	3.50	3.50	3.35	3.63	3.68
85	3.53	3.43	3.35	3.70	3.57	3.52	3.39	3.44	3.48	.	3.59	3.57
86	3.55	3.48	3.46	3.64	3.53	.	3.52	3.48	3.61	3.51	3.53	3.55
87	3.57	3.61	3.39	3.64	3.56	3.59	3.51	3.48	3.63	3.72	3.58	3.51
MEAN	3.51	3.49	3.40	3.63	3.51	3.43	3.42	3.45	3.59	3.51	3.59	3.57

TABLE 19. SUMMARY OF GPAS FOR LS PROGRAM GROUPS

GRAD YEAR	LS	PROGRAM GROUP GCA	GCM	GLM	GSM
76	3.57	.	.	3.59	3.48
77	3.57	.	.	3.59	3.50
78	3.62	.	.	3.64	3.52
79	3.64	.	.	3.61	3.69
80	3.56	.	.	3.53	3.63
81	3.56	.	.	3.51	3.62
82	3.62	.	.	3.60	3.60
83	3.58	3.58	3.70	3.54	3.61
84	3.68	3.68	3.64	3.68	3.69
85	3.65	3.62	3.55	3.68	3.59
86	3.64	3.59	3.68	3.65	3.60
87	3.64	3.50	3.66	3.61	3.73
MEAN	3.61	3.59	3.64	3.60	3.61

Tables 20 and 21 present values of LOSAFTT for EN and LS program groups, respectively. For ten of the fifteen years, the average length of service

TABLE 20. SUMMARY OF AVERAGE LENGTH OF SERVICE AFTER GRADUATION (LOSAFIT) FOR EN PROGRAM GROUPS

GRAD YEAR	EN	PROGRAM GROUP GA	GAE	GCS	GE	GEO	GEP	GNE	GOR	GSE	GSO	GST
73	10.8	13.2	10.3	.	11.0	.	11.4	9.1	8.7	11.7	.	.
74	10.1	11.6	11.1	10.3	9.9	.	11.6	11.0	10.3	4.2	.	.
75	9.9	10.3	11.2	9.6	9.9	.	12.4	8.4	9.9	8.7	.	.
76	10.0	10.4	9.7	9.9	9.7	.	10.7	13.2	11.6	11.2	.	.
77	10.4	12.2	10.5	10.1	9.7	8.5	10.9	.	11.2	.	.	.
78	8.2	5.7	9.6	7.3	8.2	9.1	7.4	11.5	8.8	9.6	.	.
79	8.1	8.5	6.7	6.1	6.6	7.6	10.1	.	11.4	6.1	.	9.4
80	7.5	10.7	6.8	6.8	7.9	8.1	7.6	.	9.1	7.6	.	9.6
81	5.7	6.1	6.7	4.9	6.1	7.1	4.6	4.6	5.7	5.3	.	6.1
82	5.8	3.8	5.8	4.3	5.1	4.6	5.7	7.6	4.1	6.1	6.7	8.2
83	5.1	.	4.2	3.9	5.2	5.1	3.0	7.3	4.6	1.5	3.9	7.1
84	4.7	4.6	4.6	4.6	4.7	4.3	5.1	6.1	4.9	.	3.0	4.6
85	4.5	6.1	4.6	3.4	3.9	3.0	3.0	3.8	4.6	.	4.9	4.6
86	3.3	3.0	4.6	2.6	3.5	.	.	3.0	3.0	.	3.0	6.1
87	3.3	.	3.0	3.0	3.0	3.0	.	.	3.0	.	3.0	.
MEAN	8.4	9.9	9.4	6.1	8.3	6.3	9.6	9.0	8.4	8.2	4.8	7.7

after graduating from AFIT (LOSAFIT) for LS graduates was lower than for EN graduates. Overall, however, the average value for LOSAFIT for each school is nearly identical at 8.4 and 8.3 for EN and LS, respectively. One unexpected result is the values for LOSAFIT for the class of 1986 and 1987 for both schools. In both of these years, LOSAFIT is less than the four year commitment period. Apparently, many of these later graduates who are leaving the Air Force are taking advantage of the Air Force's early-release program. This program, first offered in fiscal year 1988, waives portions of an officer's active duty service commitment. All Air Force officers are eligible for this program except for Air Force Academy graduates, medical officers, and rated officers. (Eligibility for rated officers is a function of their years of service). For AFIT graduates, the early-release program

TABLE 21. SUMMARY OF AVERAGE LENGTH OF SERVICE AFTER GRADUATION (LOSAFIT) FOR LS PROGRAM GROUPS

GRAD YEAR	LS	PROGRAM GROUP GCA	GCM	GLM	GSM
73	9.5	.	.	9.6	9.4
74	10.0	.	.	10.3	9.5
75	9.2	.	.	9.1	9.7
76	9.5	.	.	9.7	9.4
77	9.3	.	.	9.1	9.6
78	8.2	.	.	8.0	9.5
79	8.0	.	.	7.0	9.7
80	7.3	.	.	7.0	7.7
81	5.8	.	.	6.3	5.6
82	5.4	.	.	5.8	5.2
83	4.6	3.0	3.0	4.4	4.7
84	4.7	6.1	.	3.6	5.1
85	4.8	3.0	4.9	4.8	5.1
86	3.9	.	4.6	3.5	3.8
87	3.0	3.0	3.0	2.3	1.6
MEAN	8.4	4.1	4.4	8.7	8.3

originally waived up to one year of the four year commitment incurred upon graduation. Beginning in fiscal year 1991, up to eighteen months was waived. Currently, the Air Force is waiving the entire four year commitment of AFIT graduates.

Tables 22 and 23 present a summary of values of the total length of military service (LOSTOTAL) for both EN and LS program groups. The average values for LOSTOTAL for LS are nearly two years greater than those for EN. Two periods in particular are notably different: 1978 and 1979, when LS graduates had 2.3 and 2.2 years more total years of service than EN graduates, and 1986 and 1987, when LS graduates had 3.4 and 2.4 more years of total time in service.

TABLE 22. SUMMARY OF AVERAGE TOTAL LENGTH OF SERVICE (LOSTOTAL) FOR EN PROGRAM GROUPS

GRAD YEAR	EN	PROGRAM GROUP GA	GAE	GCS	GE	GEO	GEP	GNE	GOR	GSE	GSO	GST
73	19.5	21.8	19.7	.	19.8	.	20.0	17.3	18.0	20.3	.	.
74	19.1	20.1	20.1	19.5	19.2	.	19.4	17.9	20.3	17.5	.	.
75	19.3	19.5	20.3	20.8	20.2	.	19.6	17.9	19.9	19.6	.	.
76	19.6	17.8	19.5	18.6	20.9	21.3	20.2	21.3	21.3	19.3	.	.
77	19.5	21.3	20.4	16.2	20.3	16.7	22.1	.	18.8	.	.	.
78	16.2	10.0	17.8	17.6	17.4	13.7	16.2	17.9	17.5	19.3	.	.
79	17.6	19.5	15.8	18.3	15.4	17.3	16.2	.	21.3	21.3	.	21.8
80	16.1	19.8	13.7	14.5	17.0	13.2	9.1	.	21.3	16.7	.	19.3
81	14.3	7.6	15.2	14.0	16.2	13.7	9.1	7.6	9.5	17.5	.	21.8
82	13.9	8.4	13.5	12.0	15.2	10.1	13.7	15.2	14.2	9.1	14.6	20.4
83	12.5	.	8.8	10.9	13.3	9.1	8.4	16.4	12.2	9.1	15.2	21.3
84	11.7	10.7	9.1	12.9	13.2	6.1	12.2	10.7	12.2	.	9.9	16.7
85	12.5	22.3	10.7	11.0	12.4	.	6.1	6.8	15.2	.	13.4	16.7
86	9.6	6.1	9.1	9.6	8.7		.	9.1	9.1	.	9.1	21.3
87	9.5	.	6.1	6.1	10.9	9.1	.	.	11.2	.	9.1	.
MEAN	16.9	18.0	17.8	14.1	17.2	12.9	17.2	15.9	17.1	18.1	12.7	20.1

TABLE 23. SUMMARY OF AVERAGE TOTAL LENGTH OF SERVICE (LOSTOTAL) FOR LS PROGRAM GROUPS

GRAD YEAR	EN	PROGRAM GROUP GA	GAE	GCS	GE	GEO	GEP	GNE	GOR	GSE	GSO	GST
73	19.5	21.8	19.7	.	19.8	.	20.0	17.3	18.0	20.3	.	.
74	19.1	20.1	20.1	19.5	19.2	.	19.4	17.9	20.3	17.5	.	.
75	19.3	19.5	20.3	20.8	20.2	.	19.6	17.9	19.9	19.6	.	.
76	19.6	17.8	19.5	18.6	20.9	21.3	20.2	21.3	21.3	19.3	.	.
77	19.5	21.3	20.4	16.2	20.3	16.7	22.1	.	18.8	.	.	.
78	16.2	10.0	17.8	17.6	17.4	13.7	16.2	17.9	17.5	19.3	.	.
79	17.6	19.5	15.8	18.3	15.4	17.3	16.2	.	21.3	21.3	.	21.8
80	16.1	19.8	13.7	14.5	17.0	13.2	9.1	.	21.3	16.7	.	19.3
81	14.3	7.6	15.2	14.0	16.2	13.7	9.1	7.6	9.5	17.5	.	21.8
82	13.9	8.4	13.5	12.0	15.2	10.1	13.7	15.2	14.2	9.1	14.6	20.4
83	12.5	.	8.8	10.9	13.3	9.1	8.4	16.4	12.2	9.1	15.2	21.3
84	11.7	10.7	9.1	12.9	13.2	6.1	12.2	10.7	12.2	.	9.9	16.7
85	12.5	22.3	10.7	11.0	12.4	.	6.1	6.8	15.2	.	13.4	16.7
86	9.6	6.1	9.1	9.6	8.7		.	9.1	9.1	.	9.1	21.3
87	9.5	.	6.1	6.1	10.9	9.1	.	.	11.2	.	9.1	.
MEAN	16.9	18.0	17.8	14.1	17.2	12.9	17.2	15.9	17.1	18.1	12.7	20.1

Retention Analysis of AFIT Schools and Program Groups

There are several points that should be considered when analyzing the graphs of AFIT retention rates versus those of the Air Force at large. First, we control for commissioned time in service. We do not control for other factors such as the proportion of prior enlisted personnel, aeronautical rating, the proportion of male and female graduates, and the age of the personnel. The second point is that during the time period in which the AFIT sample attended school, each graduate incurred a four year Active Duty Service Commitment (ADSC). Therefore, their retention is naturally expected to be very high during the four years immediately following graduation. The graphical analysis starts at the first year after graduation from AFIT to present a complete picture of the actual retention rates. Third, it should be noted that the preliminary comparisons of retention rates include graduates who serve a greater number of years than required for retirement.

In addition to the graphical presentation of the retention rates for each school and program group (the graphs comparing the retention rates for program groups are presented in Appendix B), a statistical analysis (t-test) is performed to determine if a significant difference between the actual and expected retention rates exist. This analysis is limited to the periods four years after graduation and beyond. This is done to further equalize the two samples since AFIT graduates incur the four year ADSC. The results of this analysis for each school are presented later in this chapter.

Figure 1 shows the actual cumulative retention rates for EN and LS. As can be seen from the graph, the rates do not vary noticeably. The actual data used to create this graph, along with the data used to create Figures 1 - 6, are presented in Appendix C. Results of a t-test show no significant difference between the two rates (p-value=0.83). A test for a difference between the two schools was also

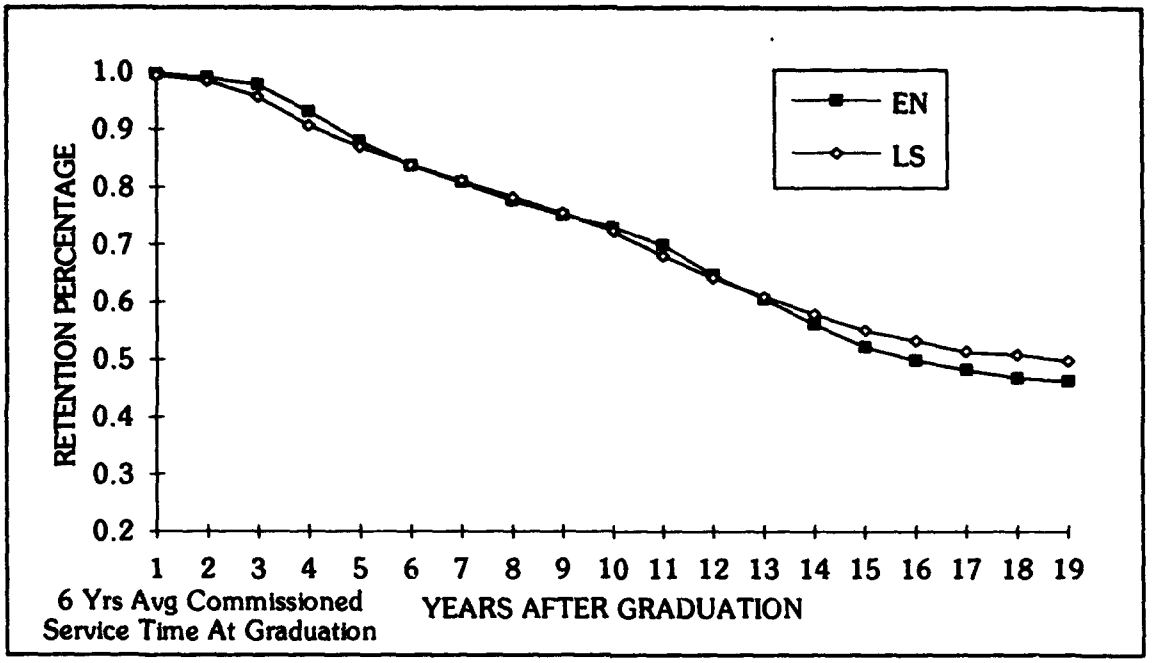

FIGURE 1. EN VERSUS LS ACTUAL RETENTION RATES

performed using a proportional hazards regression analysis. This analysis, unlike the t-test between actual rates, controls for other factors that can influence retention. The results of this analysis are presented later in this chapter. The average commissioned time is service is shown on this graph and each applicable graph hereafter. This represents the mean time in service upon graduation from AFIT for the element of the sample under consideration in each graph.

Figures 2 and 3 show the actual cumulative retention rates for all of the program groups included in the School of Engineering. Figure 2 shows those program groups in EN that have the five lowest average times in service upon graduation from AFIT and Figure 3 shows those program groups in EN that have the highest average times in service upon graduation from AFIT.

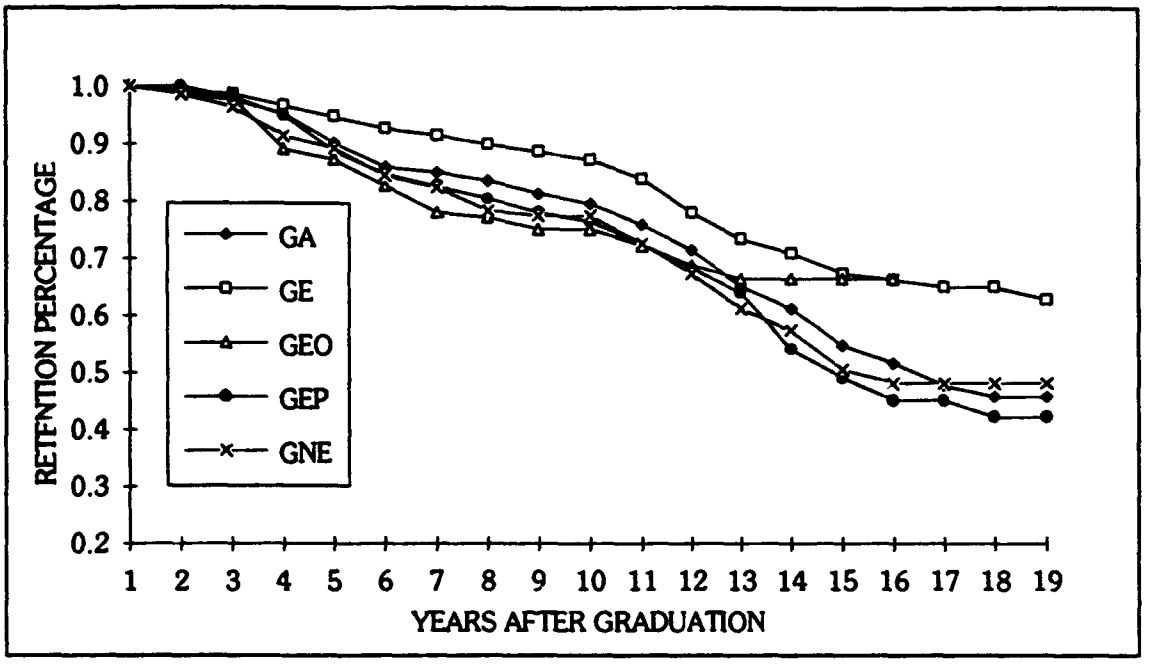

FIGURE 2. ACTUAL RETENTION RATES FOR EN PROGRAM GROUPS PART I

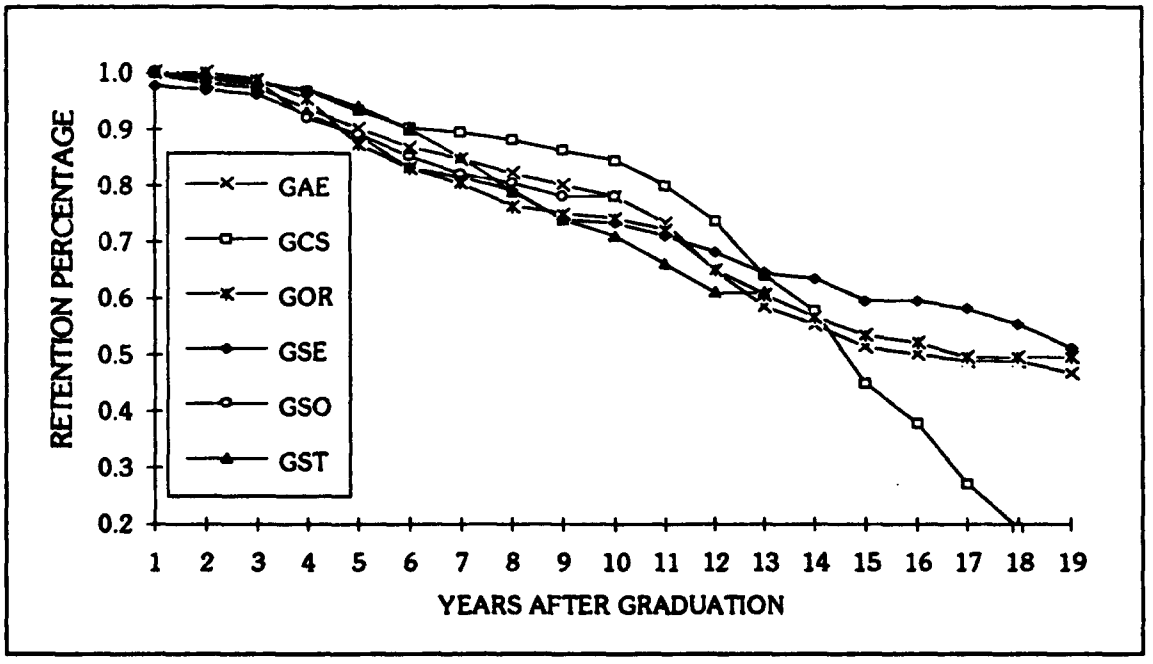

FIGURE 3. ACTUAL RETENTION RATES FOR EN PROGRAM GROUPS PART II

Figure 4 shows the actual and expected retention rates for the School of Engineering. Because of the previously mentioned four year ADSC incurred by each graduate, the expected retention rates have been normalized to 1.00 at year 0 to more accurately correspond to actuals. Apparently, the retention rate for EN graduates is higher than for similar officers in the Air Force at large. A t-test conducted on the actual versus expected retention rates shows the difference between the two sets of cumulative retention rates is significant at the 1% level.

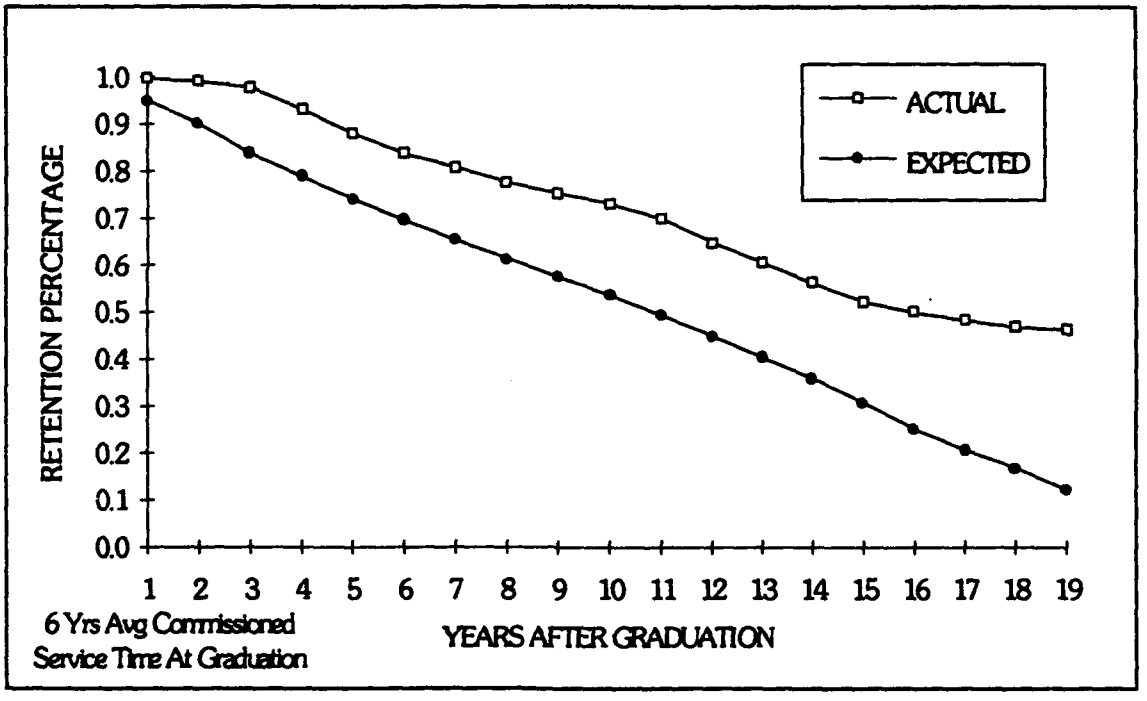

FIGURE 4. ACTUAL VERSUS EXPECTED RETENTION RATES FOR EN

One possible explanation for the difference between actual and expected retention rates involves the concept of self-selection. This concept centers on the notion that officers volunteering for AFIT do so for career advancement purposes. They may have already made the decision to stay in until they are retirement

eligible and therefore are willing to accept the four year additional service commitment that an AFIT graduate education entails. If self-selection occurs, then the retention of AFIT graduates would be expected to be greater than that of a random sample of similar Air Force officers.

Figure 5 shows the actual cumulative retention rates for all of the program groups included in the School of Systems and Logistics. The programs GCM and GCA only have data for nine years since they started in 1983. A significant drop in retention occurs at the four year point, which of course is the end of the AFIT commitment. This is more pronounced for the GCA program, which has an average length of service after AFIT of 4.1 years.

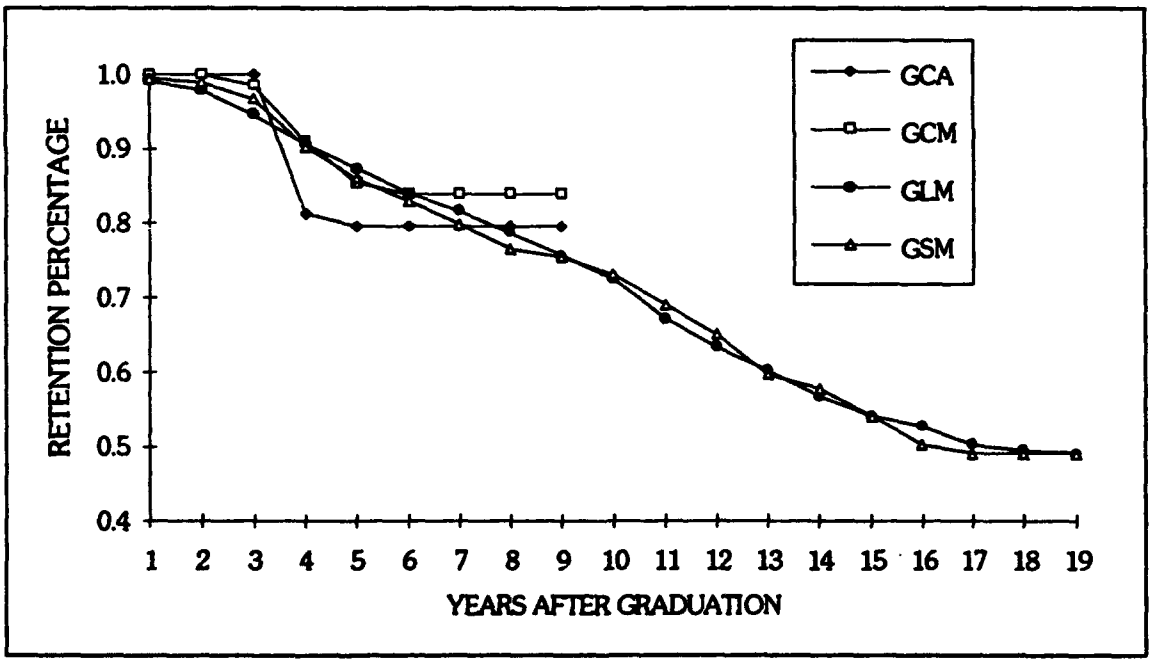

FIGURE 5. ACTUAL RETENTION RATES FOR LS PROGRAM GROUPS

Figure 6 shows the actual and expected retention rates for the School of Systems and Logistics. From the graph, the retention rates for LS graduates appear to be a higher than those of Air Force officers at large. For instance, ten

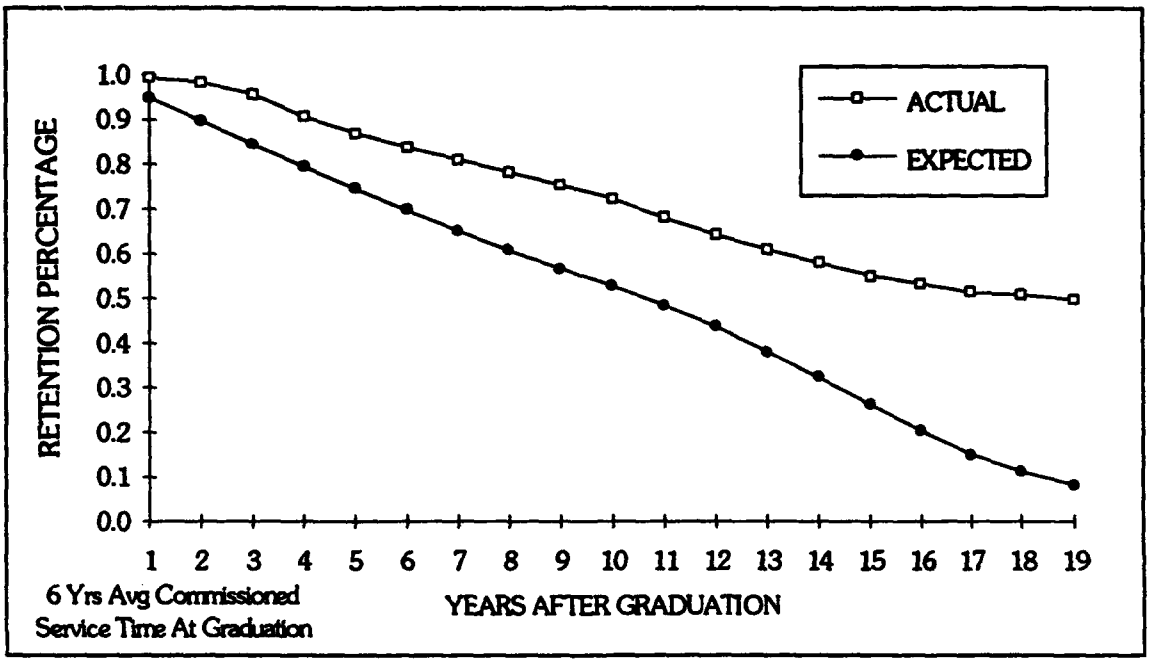

FIGURE 6. ACTUAL VERSUS EXPECTED RETENTION RATES FOR LS

years after graduation 72 percent of LS graduates are still in the service while only 53 percent of similar officers in the Air Force at large remain in the service. A t-test conducted on the actual versus expected retention rates shows the difference between the two sets of cumulative retention rates to be significant at the 1% level.

Presentation and Analysis of the Proportional Hazards Models Results

The proportional hazards model, as described in Chapter 3, facilitates the statistical analysis of "lifetime" data. The members of the population who have voluntarily separated from the Air Force represent the portion of the sample with corresponding event times. Those who are still on active duty service as of 01

April 1992 or who have retired during the nineteen year period make up the portion of the sample with corresponding censored times.

The first case considered when performing the PHREG procedure uses all of the observations in the sample of AFIT graduates from 1973 through 1987. The variables included in the initial regression equation are: LOSAFIT (the dependent variable), GRADAGE, GPA, RATED, SEX, ENSCHOOL, PRIOR, and RACE (the covariates). The results of this regression analysis are shown in Table 24. Because GRADAGE is highly correlated (r=0.91) with years of military service before entering AFIT (TOTAFIT), a potential multicollinearity problem exists. Therefore, TOTAFIT was not entered into the regression equation.

TABLE 24. RESULTS OF INITIAL REGRESSION EQUATION

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	P-VALUE
RATED	-0.326	0.133	0.015
SEX	0.521	0.160	0.001
PRIOR	-0.079	0.154	0.609
ENSCHOOL	-0.042	0.099	0.668
GPA	-0.317	0.155	0.041
GRADAGE	-0.152	0.016	0.0001
RACE	-0.205	0.308	0.505

Only 3,778 observations of the total population of 5,071 were included in the regression analysis because the PHREG procedure drops any observations that do not include information on all of the variables in the model. Of the 3,778 observations, 3,262 (86.3%) were censored. The results in Table 24 show that RATED and GPA are significant at the 5% level, and SEX and GRADAGE are significant at the 1% level. Neither a person's race, prior enlisted status, nor the school attended has a significant effect on the time spent in the service after

graduation. A negative sign on the parameter estimate reveals that that variable has a positive effect on the dependent variable, LOSAFIT. That is, the more negative the value of that variable, the longer a person will tend to stay in the Air Force after graduation. Regarding GRADAGE, GPA, RATED, and SEX, the values of the parameter estimates reveal the following: the older the person at graduation, the longer he/she will tend to stay in (older persons generally have fewer years remaining until they are eligible for retirement); the higher a person's GPA, the longer that person will tend to stay in the Air Force; rated officers in the sample tend to stay in longer than do nonrated officers; and females in the sample tend to separate from the Air Force after graduation from AFIT earlier than do males.

The results of the first model show that the variable ENSCHOOL has no effect on the intercept of the regression line. In order to determine if the slope of the regression line changes due to the ENSCHOOL variable, the next case analyzed using the PHREG procedure includes all the variables contained in the original model and also interaction terms of each variable with the indicator variable ENSCHOOL. If the slope of the regression line changes when these interaction terms are included, then the propensity of EN graduates to separate is different from that of the LS graduates. The PHREG procedure facilitates this test by allowing a joint test of selected variables. The interaction terms where tested to see if, jointly, they were significant. The result of this test show that the inclusion of these interaction terms in the model does not have a significant effect on the slope of the regression line. Therefore, the school that a student attends (and the receipt of an engineering versus a management education) does not make a

statistically significant difference in the amount of time served in the Air Force after graduation from AFIT[1].

The PHREG procedure allows for the consideration of specific cases wherein the covariates are assigned given values. Using this capability, the mean values for each of the covariates, specific to each school, are used to calculate survival curves and these curves are plotted. Due to the observations which have been censored, these survival curves estimate the proportion of graduates (not yet eligible for retirement) still in the service at respective points in time after graduation. In addition to plots for each school, a plot that represents the survival function estimate for EN students assuming LS demographic characteristics is generated. These plots are shown in Figure 7.

[1]After controlling for other sources of variance introduced by the other covariates

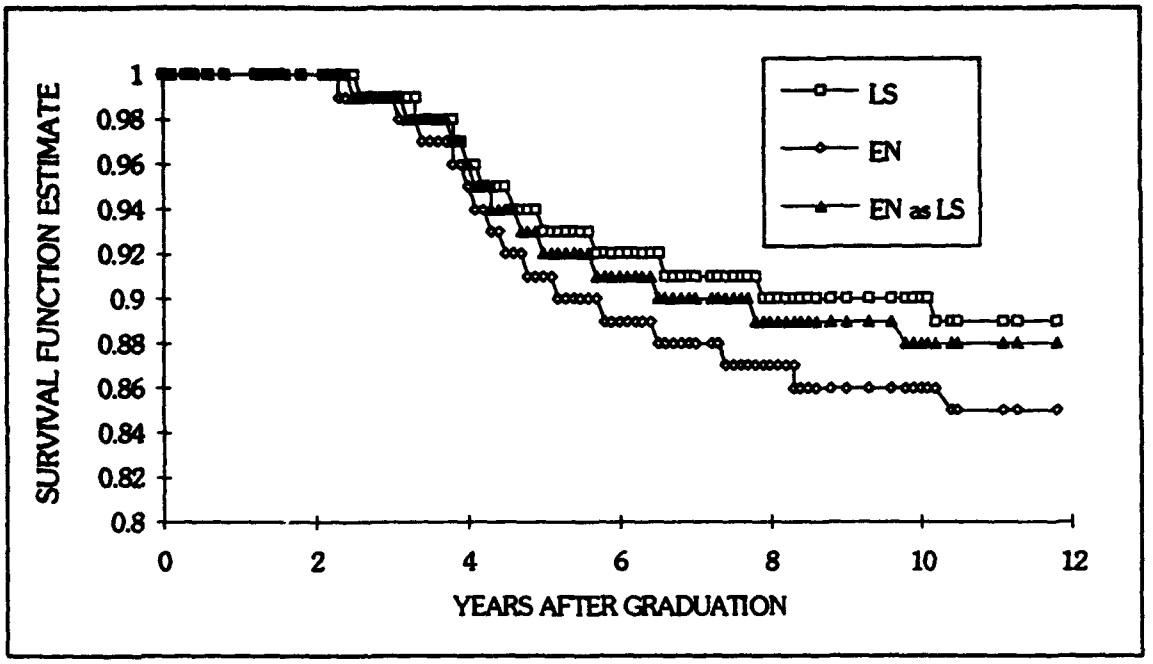

FIGURE 7. SURVIVAL CURVES FOR EN, LS AND EN AS LS

The graph of these three survival curves shows that the survival function estimate for LS students is slightly higher than it is for EN students. Also, if EN students had LS demographic characteristics, most notably a higher GRADAGE and a higher GPA, then their survival curve shifts up. These results are, of course, consistent with the results from the first PHREG regression equation, which indicates that retention increases as the age at graduation and GPA increases.

The purpose of the next portion of the PHREG analysis is twofold. First, we examine the relationship of the programs within each school and second, we consider the relationship between GPA and the time in service after graduation from AFIT in more detail. The results of a PHREG analysis using EN program groups is shown in Table 25.

TABLE 25. RESULTS OF EN PROGRAM GROUP REGRESSION EQUATION

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	P-VALUE
RATED	-0.420	0.179	0.019
SEX	0.373	0.219	0.089
PRIOR	-0.344	0.207	0.096
GPA	-0.318	0.189	0.093
GRADAGE	-0.130	0.020	0.0001
RACE	0.018	0.453	0.968
PGMGA	-0.236	0.228	0.300
PGMGAE	-0.384	0.194	0.047
PGMGCS	0.349	0.164	0.033
PGMGEO	-0.260	0.264	0.324
PGMGEP	-0.659	0.257	0.010
PGMGNE	-0.595	0.306	0.052
PGMGOR	-0.386	0.229	0.092
PGMGSE	-1.274	0.458	0.006
PGMGSO	0.373	0.251	0.137
PGMGST	-1.258	0.468	0.007

The omitted base case is the GE program group. Therefore, the coefficients of each of the program groups must be evaluated relative to the omitted GE program group. The results show that of the program groups, only Aeronautical Engineering (PGMGAE), Computer Systems (PGMGCS), Engineering Physics (PGMGEP), Systems Engineering (PGMGSE), and Strategy and Tactics (PGMGST) are significantly different from Electrical Engineering (PGMGE) at the 5% level. The results also reveal that GRADAGE and RATED are significant at the 5% level for the School of Engineering.

In order to generate survival function curves, the mean values for the covariates are used to determine a survival function estimate for EN students. Next, those same values are used but with a GPA value of 3.88, which represents the 90^{th} percentile GPA for the EN observations. This level was chosen because it is the level that must be obtained to earn the distinction of Distinguished Graduate from AFIT. The plots of the two survival function curves are shown in Figure 8.

The two survival function plots show that when the GPA of EN students goes up to 3.88, the survival rate also goes up. This relationship of a higher GPA to the time spent in the service after graduation was not foreseen. It was uncertain whether high grades would serve to increase civilian opportunities and possibly a higher income or increase military opportunities and the possibility of increased advancement. The results suggest that the returns to high grades at AFIT may be perceived to be greater in the military than in the civilian sector. As Table 25

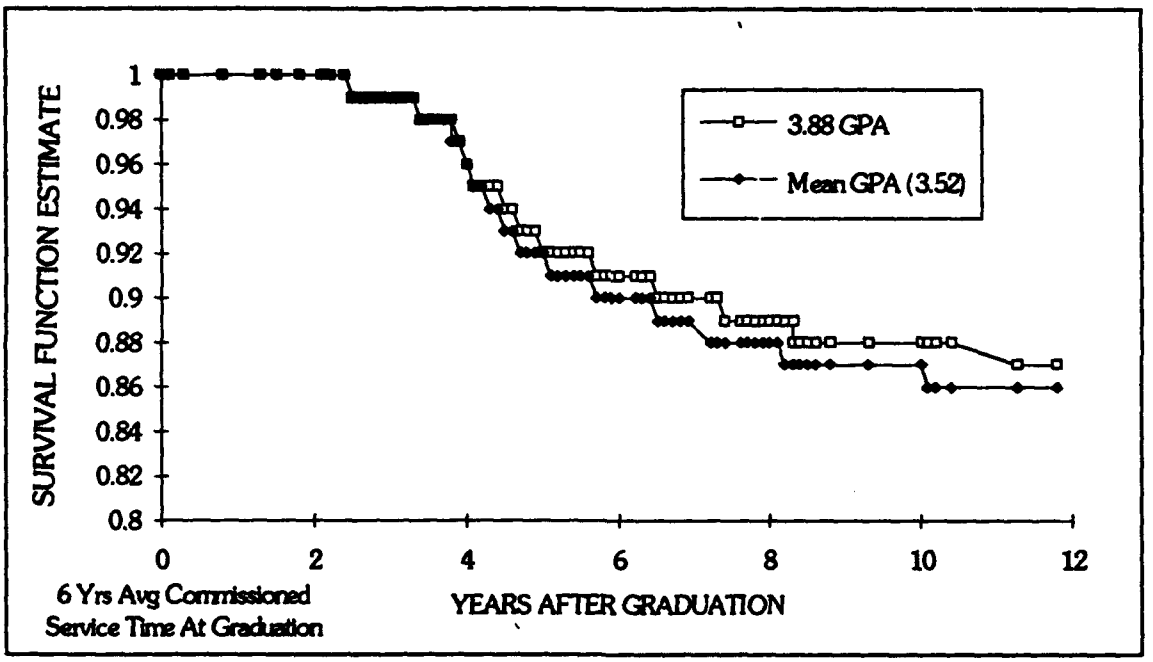

FIGURE 8. SURVIVAL CURVES FOR EN USING HIGH AND MEAN GPA

shows, GPA is significant at the 10% level. Figure 8 shows the survival curves for EN using high and mean GPAs are fairly constant up to the four-years-after-graduation point due to the incurred commitment and diverge thereafter.

The same procedures used in the previous analysis of EN program groups are used again to analyze the retention of LS students. Table 26 shows the results of the proportional hazards regression analysis for the LS program groups.

TABLE 26. RESULTS OF THE LS PROGRAM GROUP REGRESSION EQUATION

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	P-VALUE
RATED	0.042	0.205	0.836
SEX	0.595	0.237	0.012
PRIOR	0.136	0.237	0.567
GPA	-0.756	0.290	0.009
GRADAGE	-0.201	0.027	0.0001
RACE	-0.487	0.422	0.249
PGMGCA	0.275	0.371	0.460
PGMGCM	0.466	0.335	0.164
PGMGSM	-0.0001	0.161	0.999

Here, the program group GLM is the omitted base case. Therefore, the coefficients of the indicator variables for each of the included program groups should be interpreted as measuring the differential impact of that respective program group compared to the GLM program. The results show that after controlling for the influence of the other variables in the equation, the time in service after graduation from AFIT does not vary significantly between program groups. SEX, GPA, and GRADAGE are significant at the 5% level.

As with the EN analysis, the mean values for the covariates are first used to determine a survival function estimate for LS students and second, those same values are used again except that GPA is set to the 90^{th} percentile GPA of 3.93. The plots of the two survival curves are shown in Figure 9.

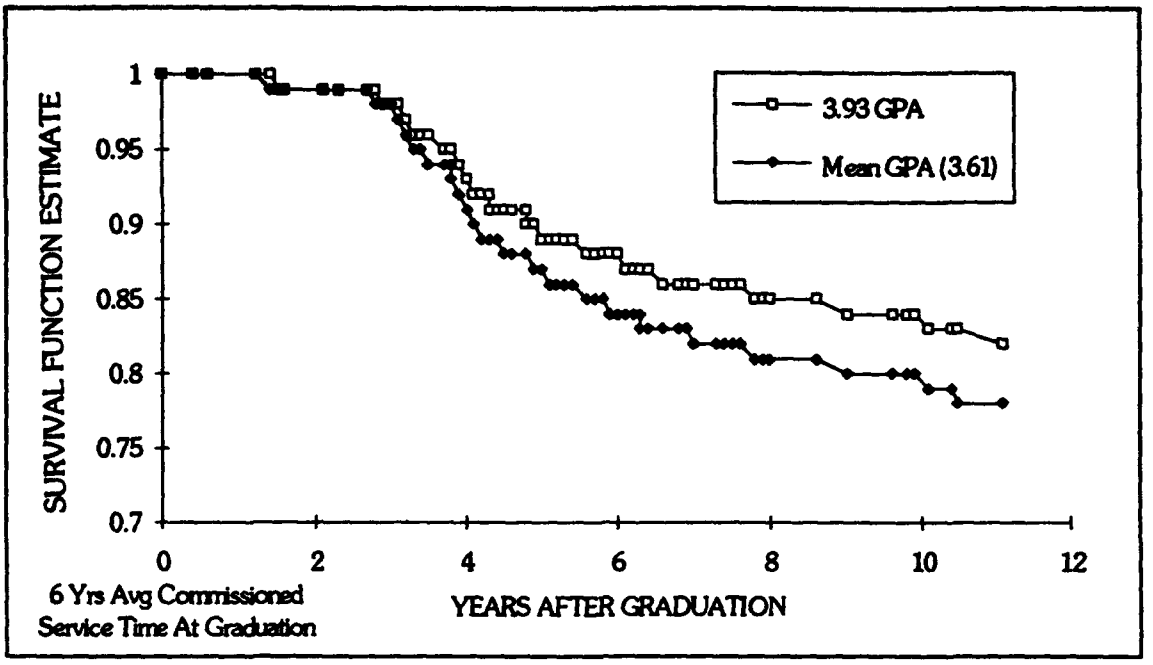

FIGURE 9. SURVIVAL CURVES FOR LS USING HIGH AND MEAN GPA

The two survival function curves show that when GPA for LS students is set to 3.93, the survival rate also goes up. The survival rates are, again, fairly constant up to the four-years-after-graduation point and then diverge thereafter.

The last part of our proportional hazards regression analysis focuses on the impact of age on retention of AFIT graduates. The results discussed previously show that GRADAGE is highly significant in determining the survival rate of students after graduation from AFIT. Therefore, the mean age at graduation (along with the means for the other covariates) was input into the regression equation for both schools and compared to an age that is representative of a service member who attends AFIT as a first assignment (age 24). The plots of the survival function estimates that result from the regression equations using the mean age versus age twenty-four for both schools are shown in Figures 10 and 11.

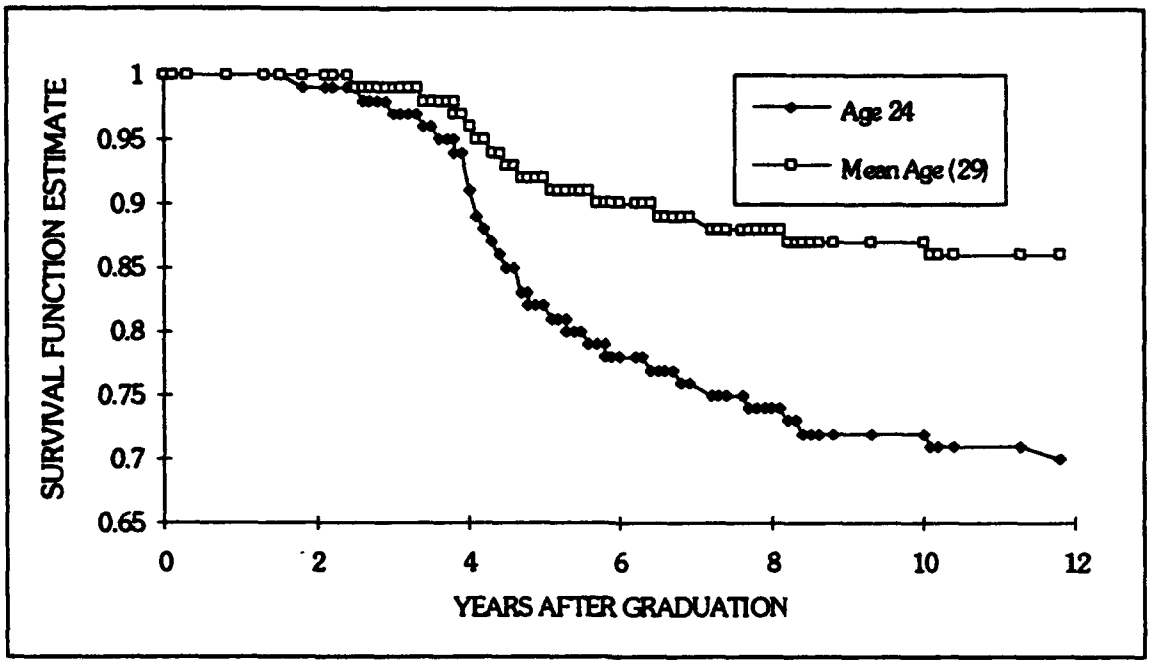

FIGURE 10. SURVIVAL CURVES FOR EN USING LOW AND MEAN AGE

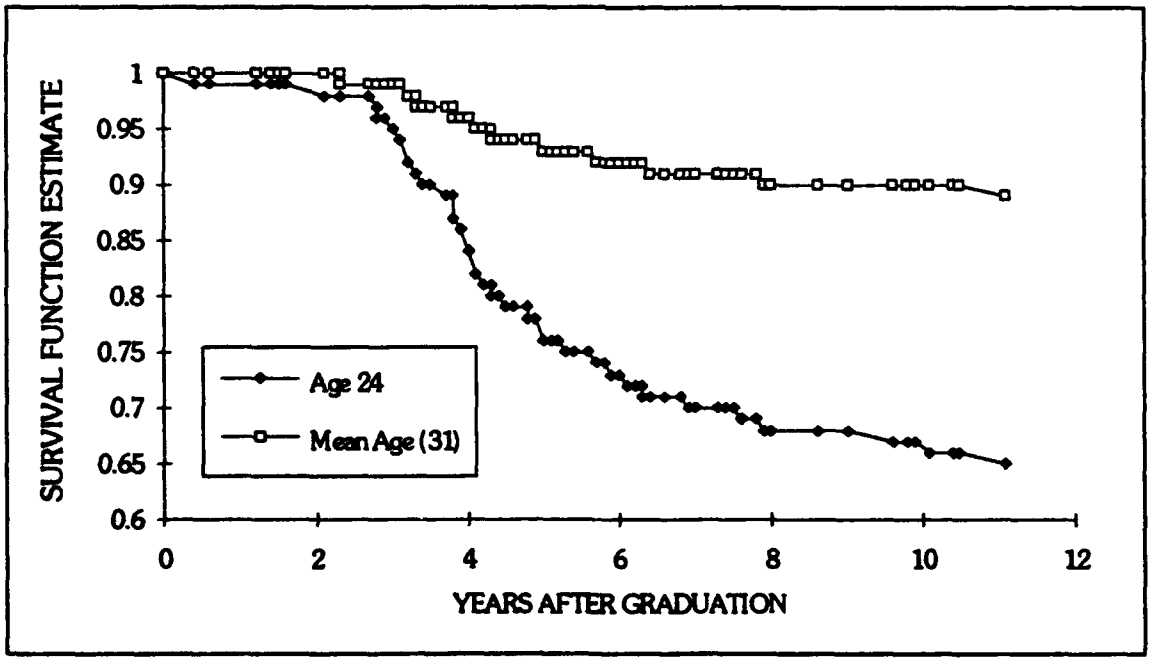

FIGURE 11. SURVIVAL CURVES FOR LS USING LOW AND MEAN AGE

The difference in the two LS survival curves is more pronounced because the mean age at graduation for LS students is higher than that of EN students--thirty-one as compared to twenty-nine. The survival curves diverge quite steadily after four years have elapsed from graduation. These curves point out that young officers, having AFIT as their first assignment, are significantly more likely to separate from the service sooner than older officers. These results suggest that AFIT should not be a first assignment for officers since they are more likely to separate from the Air Force than an officer who comes to AFIT with one, or possibly two, assignments already completed. The tradeoff that exists with this policy is that the Air Force's younger officers would not have the benefit of an advanced education. Also, as stated previously, the older officer attending EN would not have a recent education to draw on to help them through the advanced engineering curriculum (assuming an undergraduate degree was obtained several years earlier).

IV. Summary, Conclusions and Recommendations for Future Research

Introduction

The intent of this study was threefold. The first objective was to provide a demographic and retention summary of a sample of AFIT officer graduates by degree program and year of graduation. The second objective of this thesis was to determine if the retention rates of AFIT officer graduates (identified separately as graduates of specified degree programs in the School of Engineering and graduates of the School of Systems and Logistics) differ significantly from that of Air Force officers as a whole (excluding rated officers and specialists such as medical officers and chaplains). The third objective was to use proportional hazards regression analysis to study survival function estimates of Air Force officers graduating from AFIT between the years 1973 and 1987. This chapter presents a summary of the major findings of this study, draws conclusions regarding those findings, and provides several recommendations for follow-on research.

Summary

Descriptive Statistics. The descriptive statistics reveal several differences between the schools of Engineering and Systems and Logistics. Engineering students are nearly two years younger at graduation than LS graduates, have approximately two fewer years of service coming to AFIT than LS graduates, and remain in the service two years less, on average, than LS graduates. There is little difference in the percentages of females, rated officers, and officers with prior enlisted service between the two schools. Demographic data was also tabulated for the fifteen program groups within the two schools.

Retention Analysis. Actual retention rates of the graduates from both schools and also the program groups within each school were compared to normalized expected rates that were determined from AF MPC retention data. The AF MPC retention rates were normalized so that these retention rates could be compared to the actual rates that reflect retention after graduation from AFIT. The differences between the actual and expected rates for all EN and LS programs are significant at the 1% level. Results of the statistical test of the difference between actual and expected rates for each program group are shown in Table 27.

Estimation of Survival Curves Using Proportional Hazards Regression Analysis. The original sample of 5,071 AFIT graduates was split into two distinct groups. The first group consists of students who had separated from the Air Force during the period between 1974 and March 1992. The times between graduation of these students and their eventual separation were considered event times. The second group consists of students who are either still on active duty or have since retired from the Air Force. The time between graduation and 01 April 92 are censored times for those members still on active duty. The times between graduation and retirement for the retirees are also censored. Although for censored observations we do not know the length of voluntary military service, proportional hazards regression is able to use these censored observations in analyzing the proportion of officers still in the military at times before and up to the observed length of service. The proportional hazards regression analysis procedure estimated survival curves that show the proportion of officers (among those who are not eligible for retirement) expected to still be in the service in the years following AFIT graduation. We estimated these curves for both EN and LS and also performed a sensitivity analysis using different assumed values for GPAs and age at graduation.

Considering the entire sample of AFIT graduates, GPA, age at graduation, sex, and aeronautical rating were found to be significant in influencing the time spent in the service after graduating from AFIT. That is, a higher GPA, a higher age, being male, and having an aeronautical rating increased retention. The school attended was not a significant determinant. Separating the sample of students into engineering students and management students showed that for EN students, retention was increased by a higher GPA, being older at graduation, being male, or by having an aeronautical rating. Prior enlisted status significantly decreased the retention of EN students. For LS students, retention was increased by a higher GPA, being older at graduation, and by being male. Sensitivity analysis using survival curve plots for each school confirms the effects of a higher GPA and age at graduation on retention. LS students have a higher survival curve than EN students but when EN students are given the demographic characteristics of LS students, the difference between the two survival curves decreases. This is most likely due to the differences in GPAs and age at graduation of the graduates.

Conclusions

There appears to be no trend in either the demographics of Air Force officers selected for AFIT or in the performance (i.e., GPA) of these officers at AFIT: the demographics of AFIT graduates has remained constant. Because of their relative ease of collection, demographic data can be useful and practical in the analysis of retention. One unique aspect of our study is that demographic and actual turnover data for a period covering nearly twenty years has been collected.

The retention rate of AFIT graduates is significantly higher than of the Air Force at large. Two probable reasons for the higher rate are first, there is most likely some degree of self-selection that exists among those officers who choose to attend AFIT, and second, they perhaps perceive the return on their AFIT education

to be greater if they pursue a military career. This high retention rate suggests that the Air Force is receiving a good return on its education investment.

The actual retention rates between the School of Engineering and the School of Systems and Logistics are not significantly different. Therefore, the value of an engineering degree as opposed to a management degree does not appear to influence a quit/stay decision. This conclusion is based on comparisons of the actual and expected retention rates and also from the results of the proportional hazards regression analysis.

The use of job survival duration as an index of turnover is rarely cited in major reviews (16:1313). Such a time-based continuous measure is a much stronger criterion variable than simply differentiating between those who leave an organization and those who stay, especially since military careers can span well over twenty years. Using this method, GPA and age at graduation arise as factors that have a significant influence on the survival estimates of both EN and LS students. A higher GPA leads to a higher survival rate. Students seem to value this higher GPA as a possibility for increased advancement in the Air Force as opposed to increased civilian opportunities. A higher age at graduation also leads to a higher survival rate. Older graduates have correspondingly more tenure and less time to serve before they become retirement eligible, and the value of retirement benefits are relatively high for these members.

There are several potential benefits of this research. New demographic information is now available to policy makers. With respect to retention, AFIT administrators now have data suggesting that there is a high return on the educational investment. This supports the Air Force's goal of retaining a highly trained force. Finally, factors that influence retention have been identified. Obviously, such factors as sex and race cannot be used as considerations in

selecting officers for AFIT programs. However, age and, in some cases, prior service and rating can be considerations. Also, better-informed policy decisions can be made since the factors influencing retention and the actual retention rates of Air Force AFIT graduates are now known.

Recommendations for Future Research

The results of this research can form the core for many other studies regarding retention issues. An extensive database with 5,071 complete, graduate records, each with over one dozen variables, now exists for future research purposes. Future researchers may wish to conduct an economic analysis of retention. That is, the relationship between retention and economic variables such as comparable civilian income can be studied. In addition, the relationship between economic indicators such as unemployment rates and retention can be analyzed. Research has also been conducted on the cost of obtaining a civilian education. One possibility is to use this data to estimate the returns to the Air Force for an AFIT education.

Research can also be done using methods similar to those employed in this thesis on graduates of the Civilian Institute Program (CIP). Perhaps there is a difference between the applicability of the CIP curriculum and AFIT curriculum to the Air Force, so that CIP graduates perceive better opportunities to apply their education in the civilian sector.

Finally, the issue of AFIT graduate retention can be viewed from a behavioral viewpoint. Many such retention studies focus on perceived alternatives and intentions to quit or stay. AFIT graduates can be surveyed to gather such information and the results analyzed to determine the relationship of such factors to the actual retention rates exhibited by the sample of graduates in this study.

Appendix A: Glossary of Terms

ADSC - Active Duty Service Commitment

AFIT - Air Force Institute of Technology

AFIT/RR - AFIT Registrar's office

AF MPC - Air Force Military Personnel Center

Distinguished Graduate - An honor proffered on students graduating with a GPA in the 90th percentile

DMDC - Defense Manpower Data Center

DOD - Department of Defense

DOS - Variable denoting date of separation from active duty

EN - School of Engineering

ENSCHOOL - Variable denoting the particular school within AFIT that a student attends

GA - Graduate Astronautical Engineering program group

GAE - Graduate Aeronautical Engineering program group

GCA - Graduate Cost Analysis program group

GCM - Graduate Contract Management program group

GCS - Graduate Computer Systems program group

GE - Graduate Electrical Engineering program group

GEM - Graduate Engineering Management program

GEO - Graduate Electro-Optics program group

GEP - Graduate Engineering Physics program group

GLM - Graduate Logistics Management program group

GNE - Graduate Nuclear Engineering program group

GOR - Graduate Operations Research program group

GPA - Grade Point Average

GRADAGE - Variable denoting age at graduation

GRADDATE - Variable denoting graduation date

GSE - Graduate Systems Engineering program group

GSM - Graduate Systems Management program group

GSO - Graduate Space Operations program group

GST - Graduate Strategic and Tactical Sciences program group

LOSAFIT - Variable denoting length of service after AFIT

LOSTOTAL - Variable denoting total length of service served until separation or retirement

LS - School of Systems and Logistics

OTS - Officer Training School

PGMGA - Variable denoting the GA program group

PGMGAE - Variable denoting the GAE program group

PGMGCA - Variable denoting the GCS program group

PGMGCM - Variable denoting the GCM program group

PGMGCS - Variable denoting the GCS program group

PGMGCS - Variable denoting the GCS program group

PGMGEO - Variable denoting the GEO program group

PGMGEP - Variable denoting the GEP program group

PGMGNE - Variable denoting the GNE program group

PGMGOR - Variable denoting the GOR program group

PGMGROUP - Program Group

PGMGSE - Variable denoting the GSE program group

PGMGSM - Variable denoting the GSM program group

PGMGSO - Variable denoting the GSO program group

PGMGST - Variable denoting the GST program group

PHREG (Proportional Hazards REGression) - a SAS® procedure used to analyze survival or "lifetime" data

PRIOR - Variable denoting prior enlisted status

RACE - Variable denoting ethnic groups

RATED - Variable denoting aeronautical rating

RIF - Reduction in Force

ROTC - Reserve Officer Training Corps

SAS® - Mainframe statistical software from the SAS Institute

SEX - Variable denoting a student's gender

SSN - Social Security Number

STATISTIX© - Personal Computer statistical software package

TAFCSD - Total Active Federal Commissioned Service Date

TAFMSD - Total Active Federal Military Service Date

TIMEIN - Variable denoting the total length of service for officers still in the Air Force up through March 1992

TOTAFIT - Variable denoting total military service time prior to beginning the AFIT program

USAF - United States Air Force

VAX - Mainframe computer system

Appendix B: Actual versus Expected Retention Rates for each Program Group

Actual versus expected cumulative retention rates are gathered and computed for each program group. Figures 12 - 26 show the results. Table 27 in chapter 4 summarizes the statistical significance of the difference between actual and expected rates for each program.

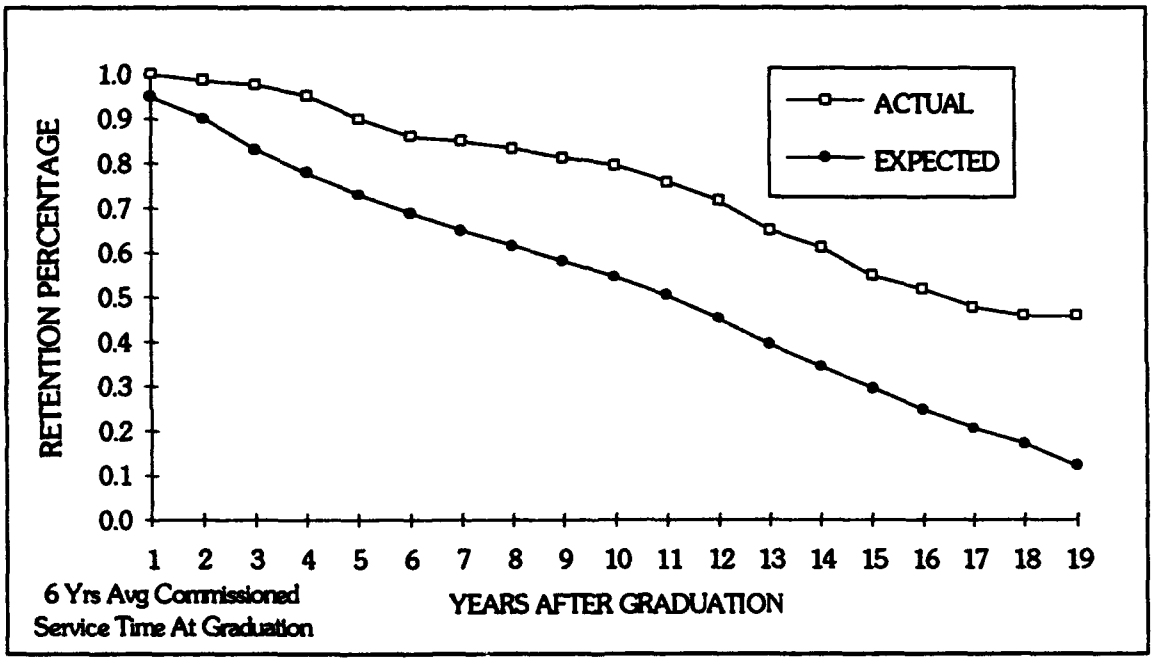

FIGURE 12. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GA

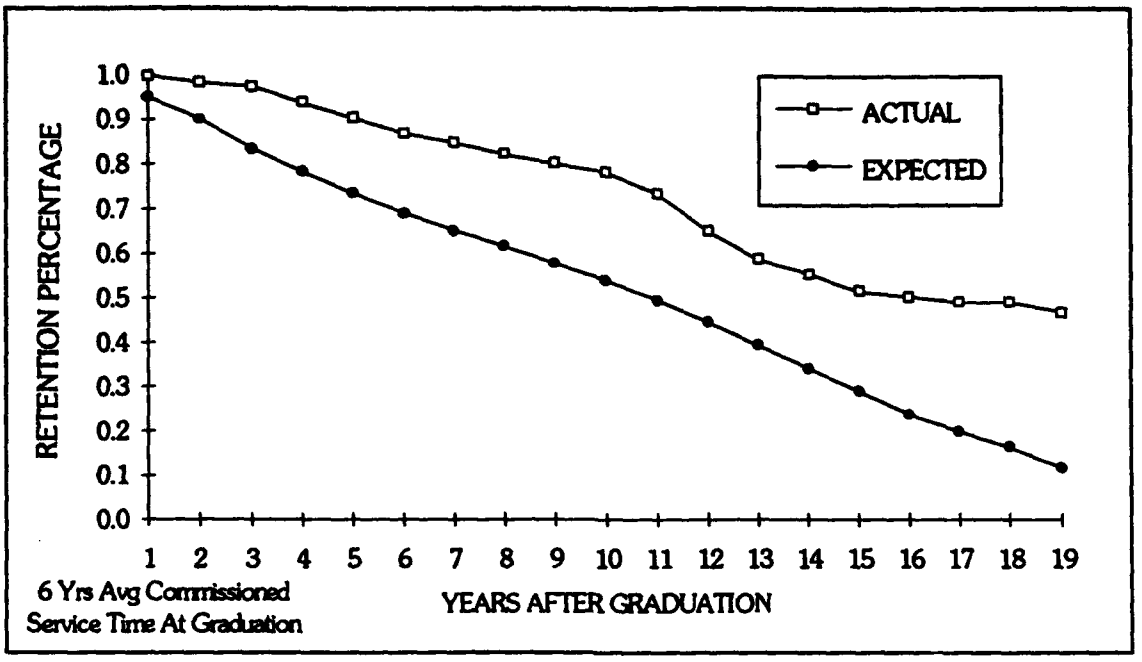

FIGURE 13. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GAE

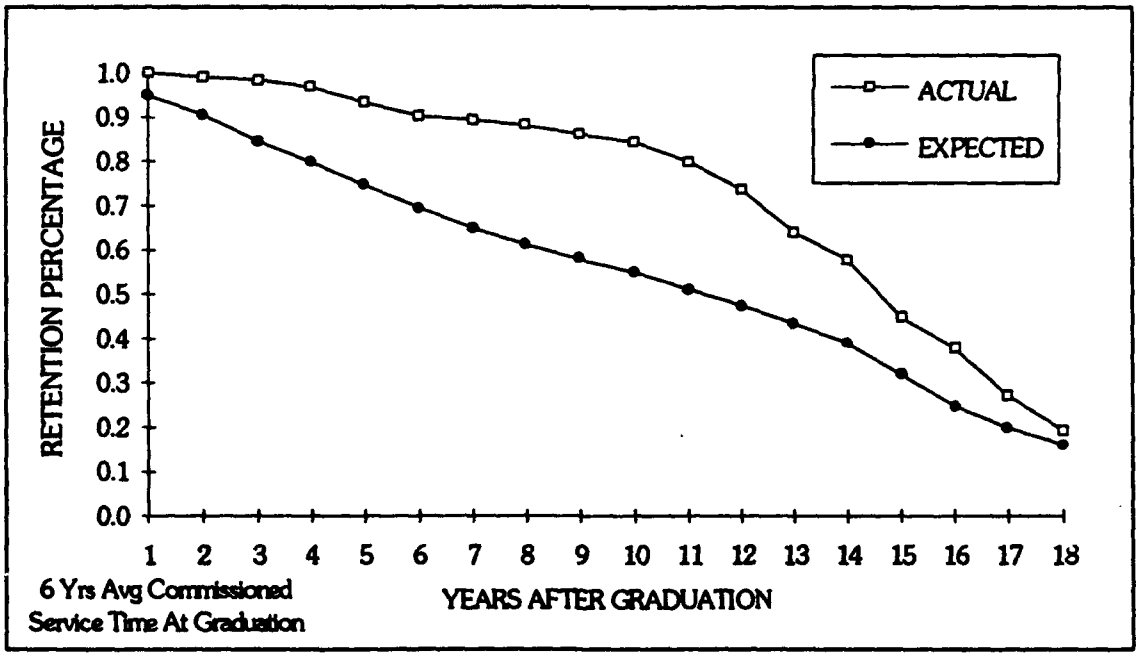

FIGURE 14. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GCS

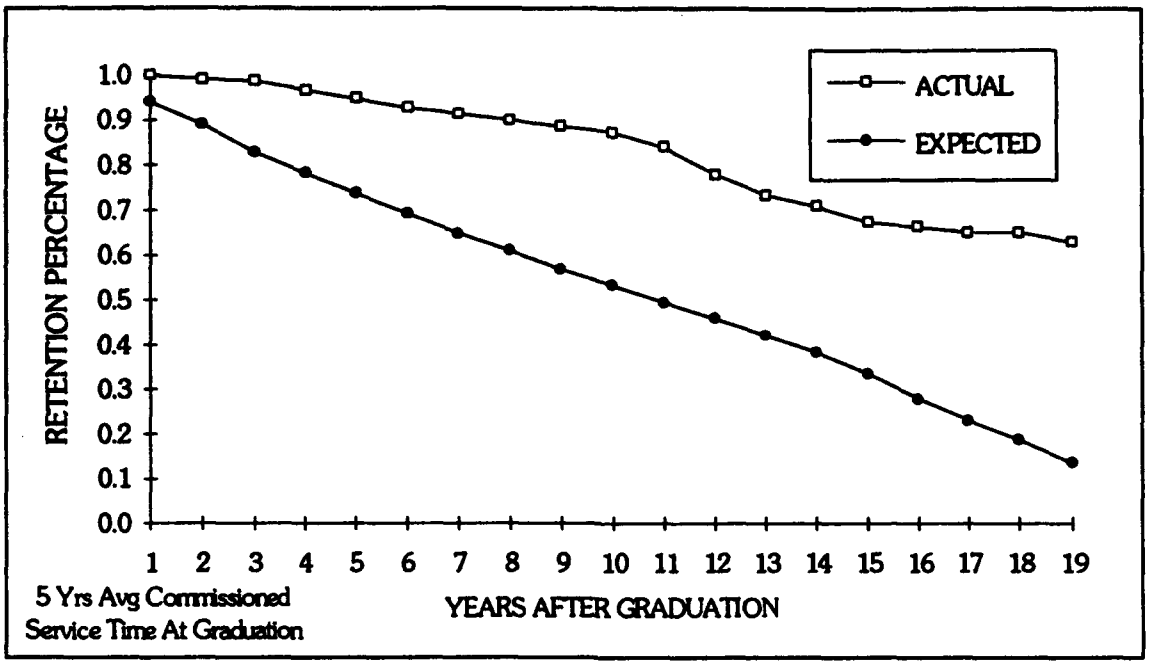

FIGURE 15. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GE

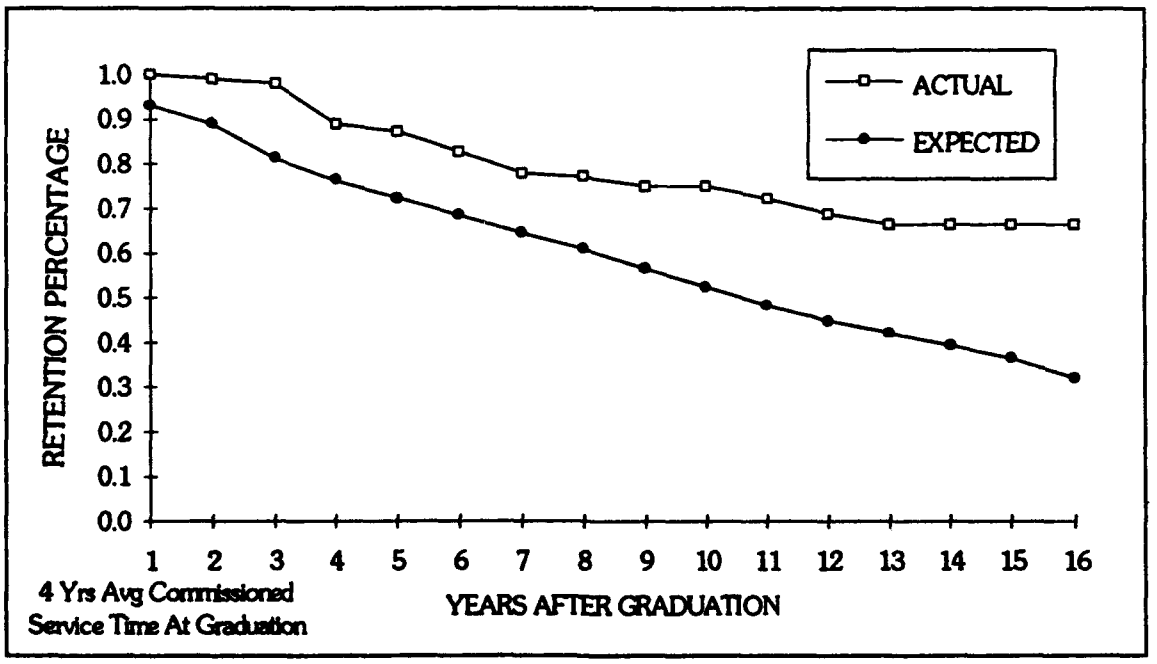

FIGURE 16. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GEO

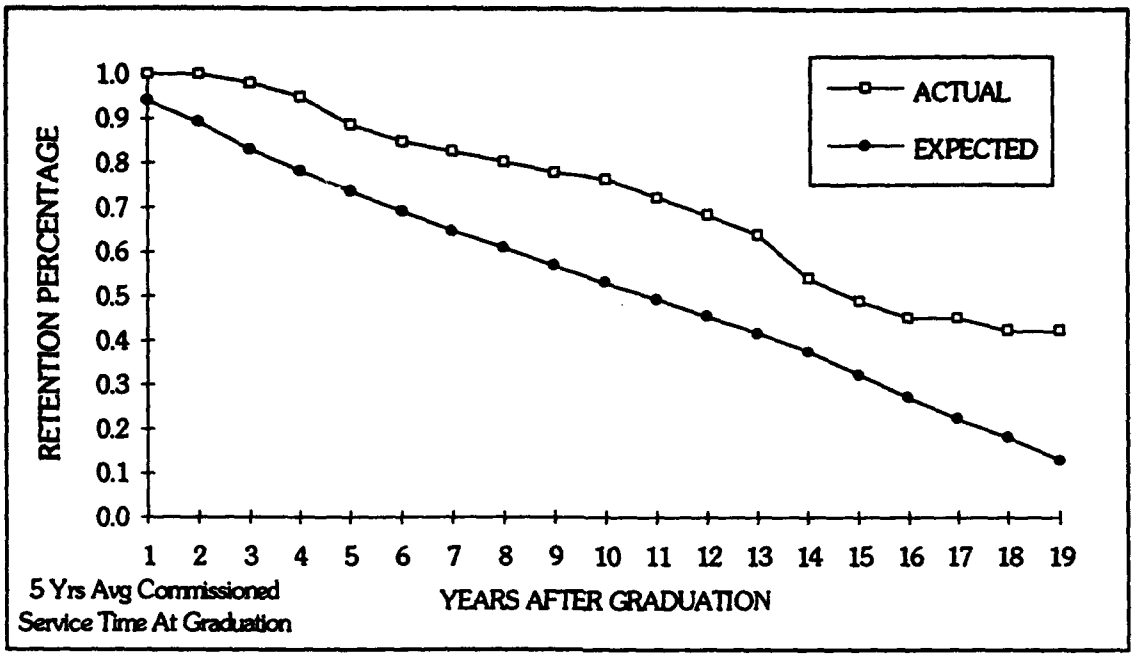

FIGURE 17. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GEP

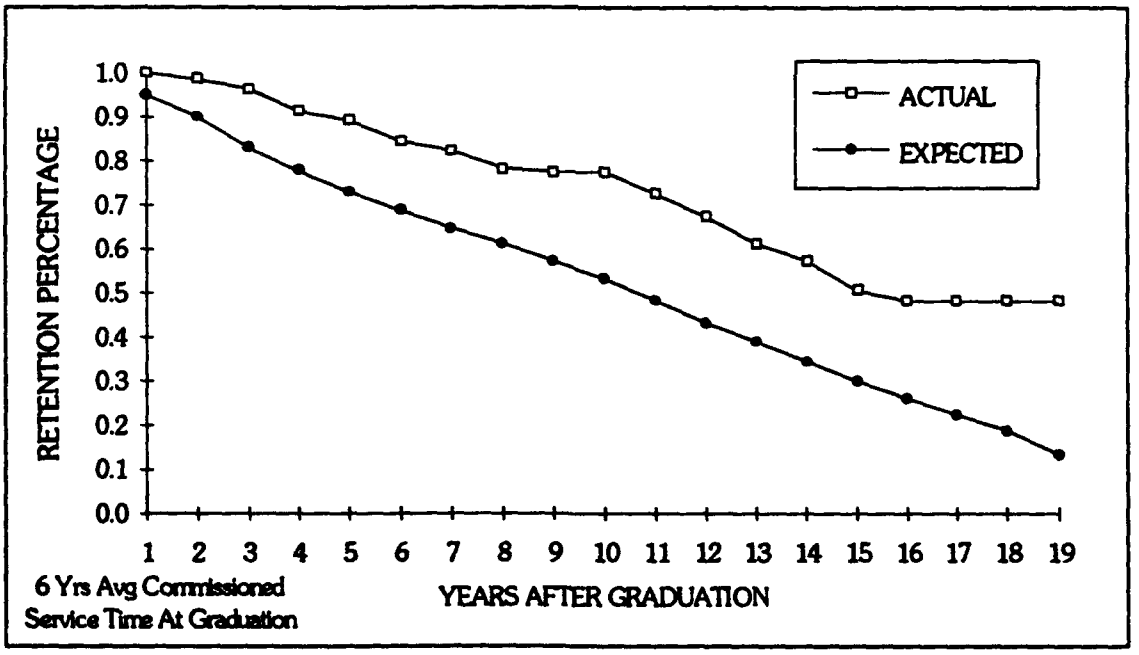

FIGURE 18. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GNE

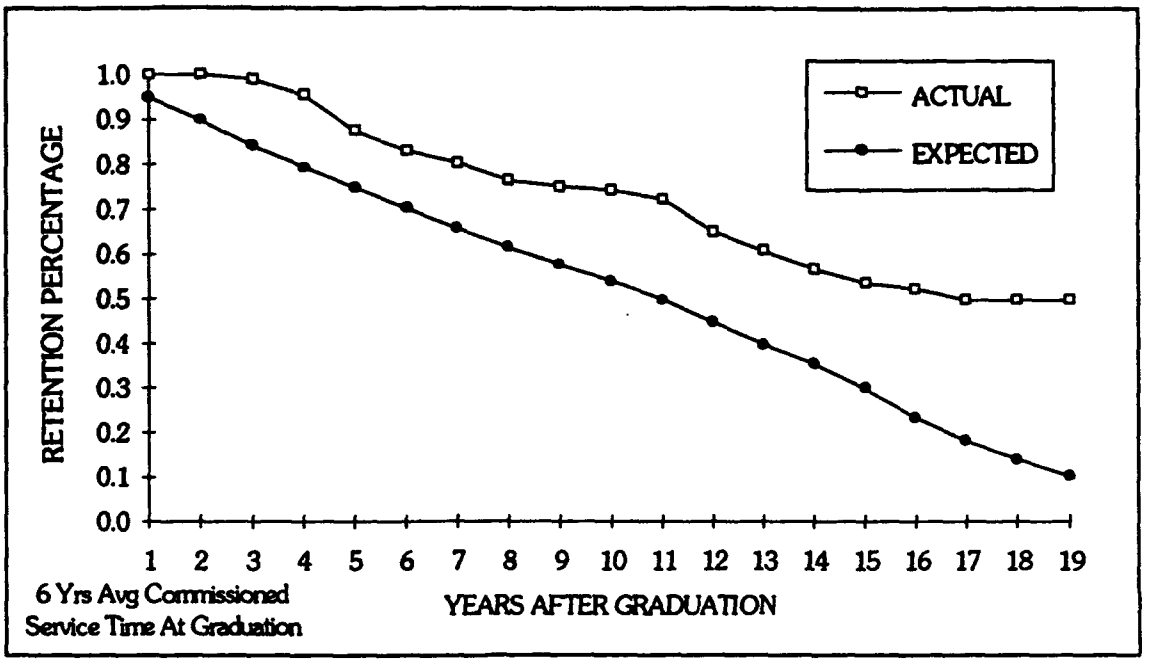

FIGURE 19. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GOR

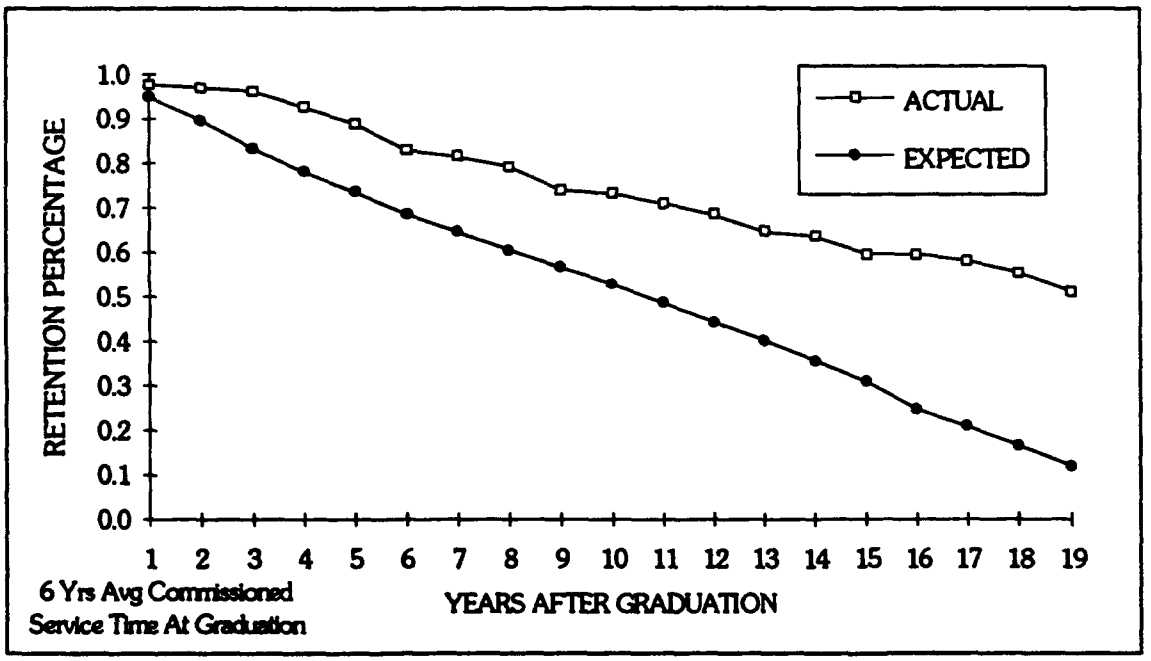

FIGURE 20. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GSE

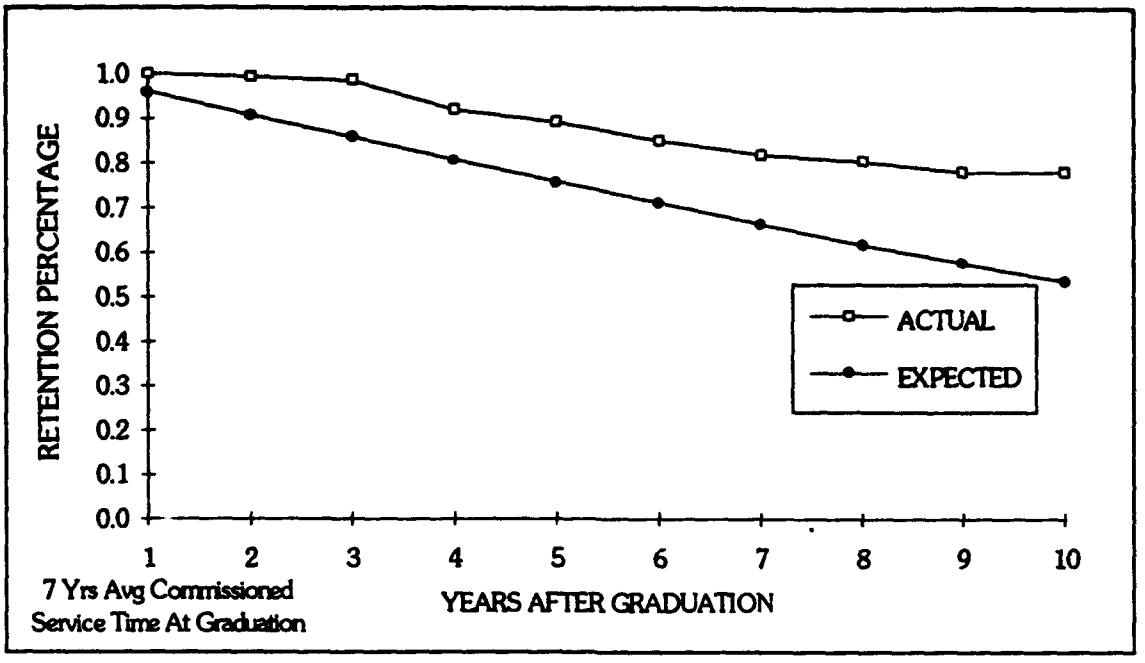

FIGURE 21. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GSO

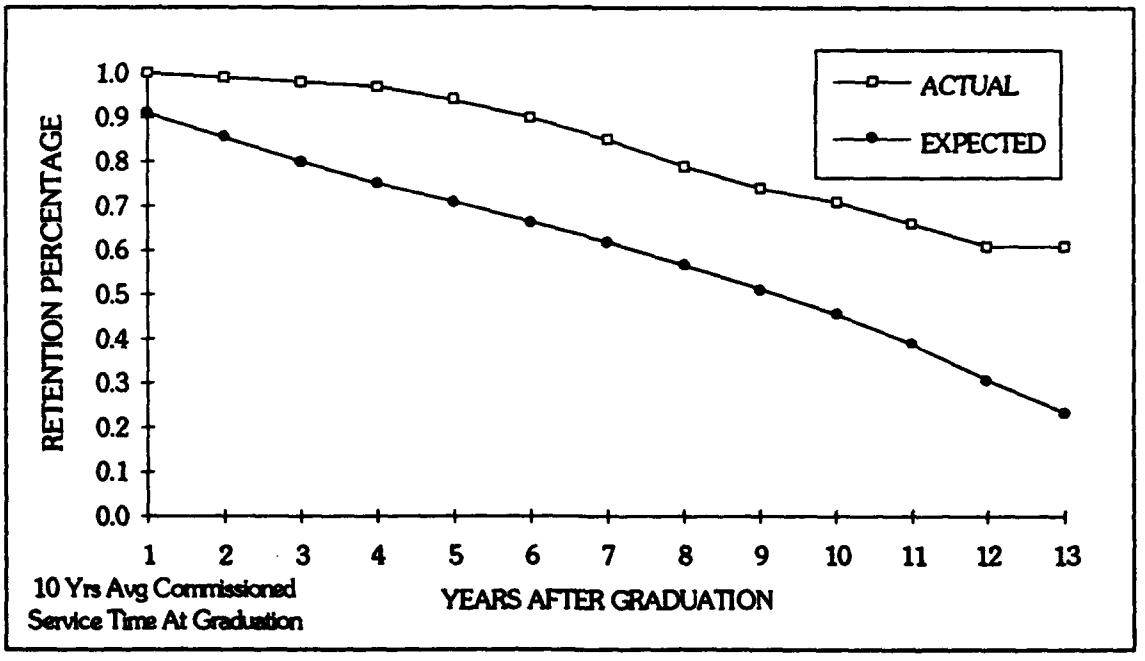

FIGURE 22. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GST

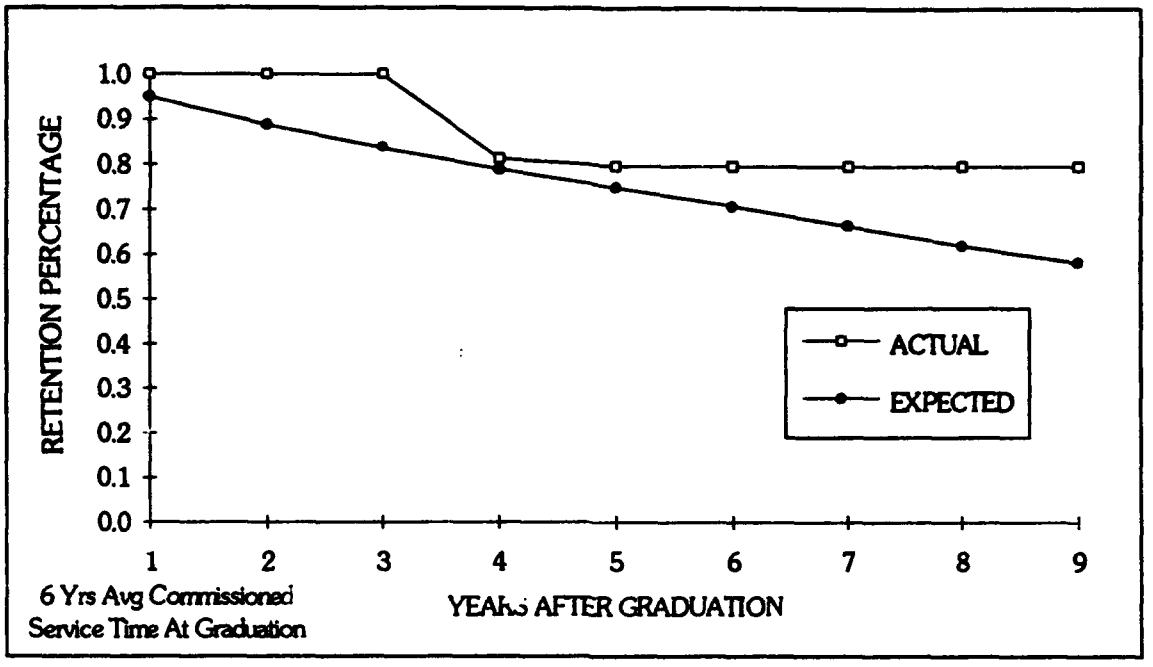

FIGURE 23. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GCA

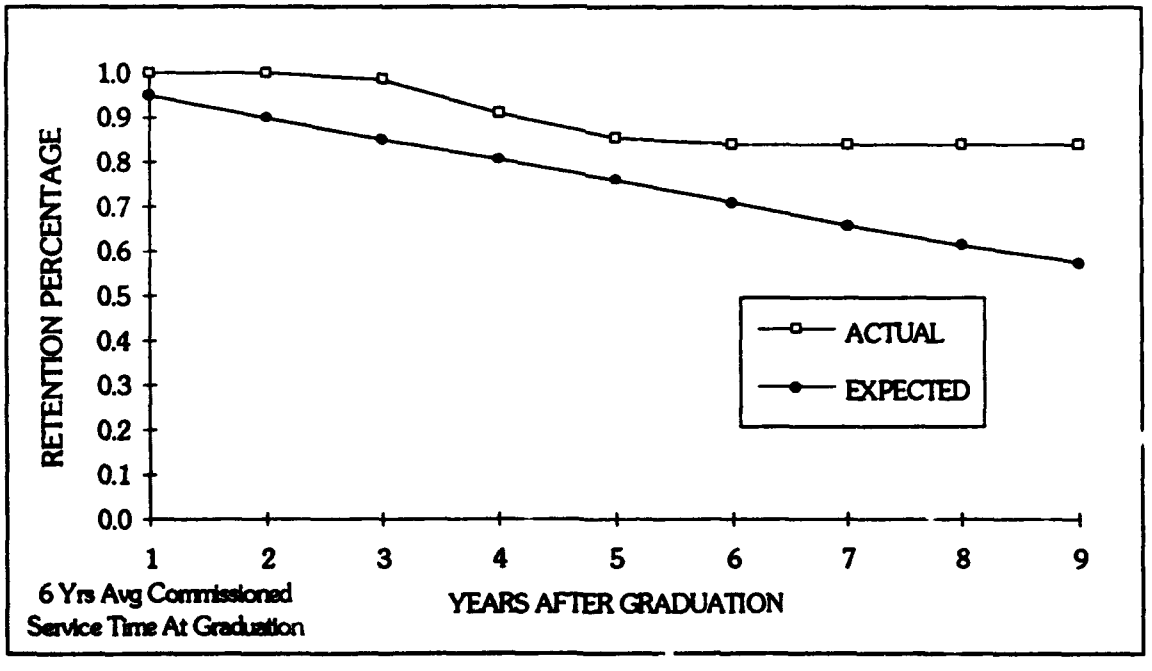

FIGURE 24. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GCM

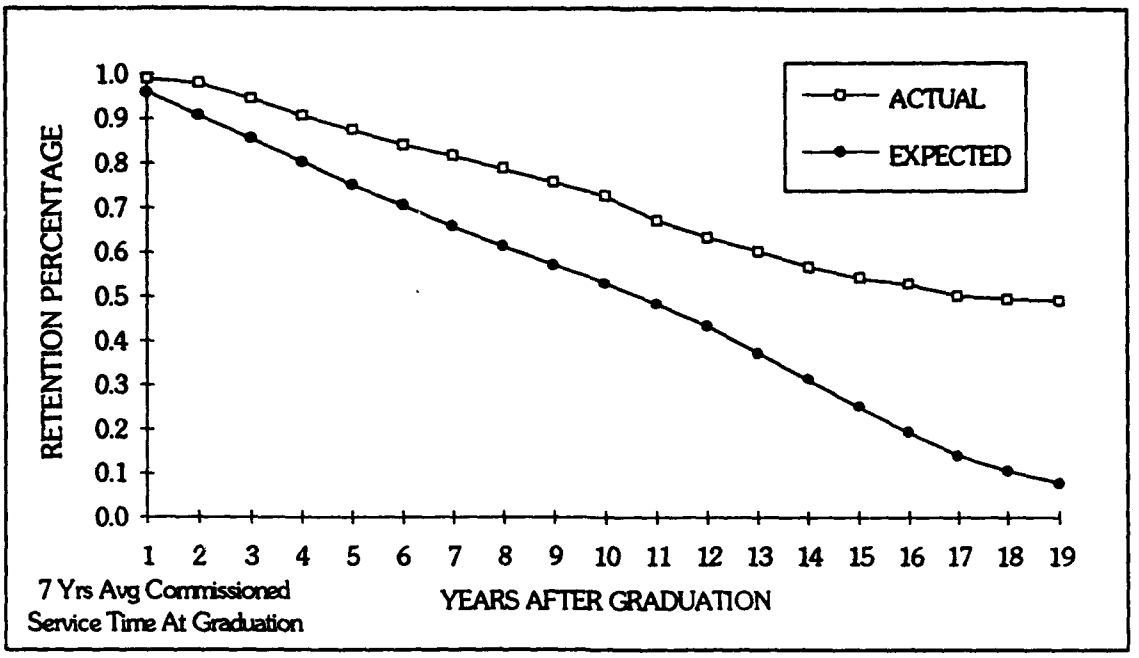

FIGURE 25. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GLM

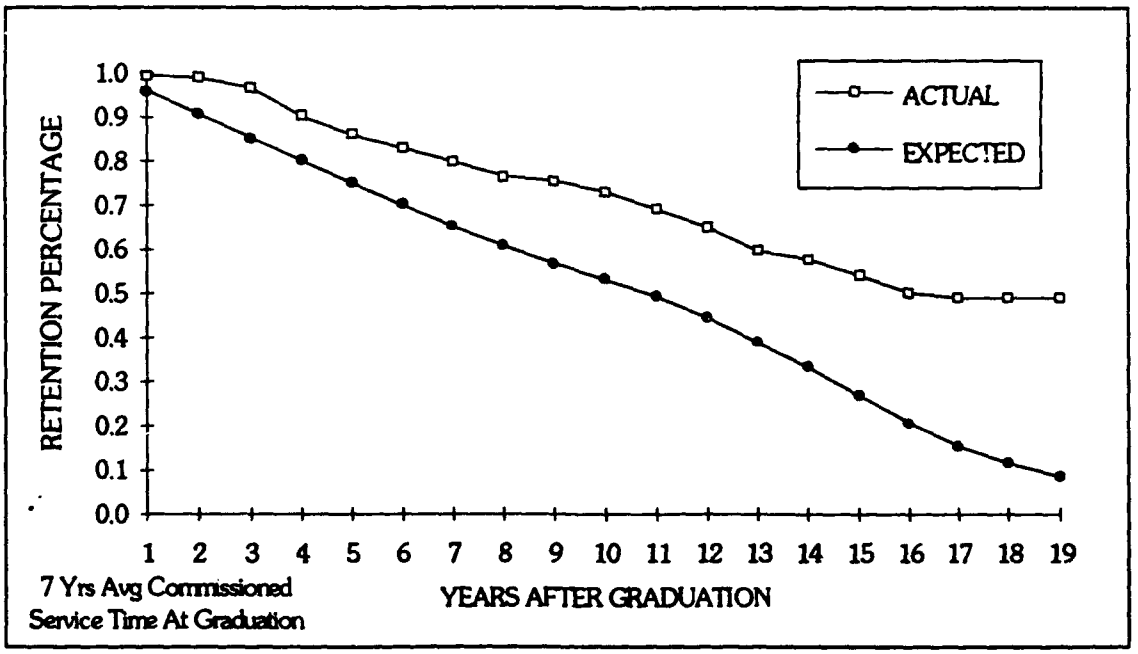

FIGURE 26. ACTUAL VERSUS EXPECTED RETENTION RATES FOR GSM

Appendix C: Data Tables for Selected Graphs

Table 27 contains the data used to create the graphs of actual versus expected retention rates for both EN and LS. Tables 28 and 29 show the data used to create the actual retention rates for EN and LS program groups, respectively.

TABLE 27. ACTUAL AND EXPECTED RETENTION RATES FOR EN AND LS

YRS SVC POST AFTT	EN ACTUAL	EN EXPECTED	LS ACTUAL	LS EXPECTED
1	0.996	0.950	0.993	0.950
2	0.989	0.900	0.984	0.897
3	0.977	0.837	0.956	0.844
4	0.931	0.787	0.907	0.795
5	0.880	0.741	0.869	0.745
6	0.837	0.695	0.838	0.698
7	0.808	0.652	0.811	0.651
8	0.776	0.613	0.782	0.607
9	0.751	0.573	0.754	0.566
10	0.730	0.536	0.723	0.528
11	0.699	0.494	0.681	0.485
12	0.648	0.449	0.642	0.437
13	0.605	0.404	0.610	0.381
14	0.562	0.359	0.579	0.324
15	0.521	0.307	0.551	0.263
16	0.499	0.251	0.533	0.203
17	0.482	0.207	0.513	0.150
18	0.468	0.169	0.509	0.113
19	0.463	0.122	0.498	0.083

TABLE 28. ACTUAL RETENTION RATES FOR EN PROGRAM GROUPS

YRS SVC POST AFIT	GA	GAE	GCS	GE	GEO	GEP	GNE	GOR	GSE	GSO	GST
1	1.000	0.998	1.000	0.999	1.000	1.000	1.000	1.000	0.977	1.000	1.000
2	0.985	0.982	0.990	0.991	0.990	1.000	0.985	1.000	0.970	0.993	0.990
3	0.976	0.974	0.984	0.986	0.980	0.981	0.963	0.989	0.962	0.985	0.980
4	0.952	0.937	0.968	0.966	0.890	0.949	0.913	0.954	0.926	0.919	0.970
5	0.901	0.902	0.933	0.947	0.872	0.887	0.892	0.874	0.890	0.892	0.940
6	0.860	0.868	0.902	0.927	0.827	0.848	0.844	0.830	0.830	0.852	0.900
7	0.850	0.847	0.894	0.914	0.780	0.826	0.823	0.804	0.815	0.820	0.850
8	0.835	0.822	0.881	0.899	0.771	0.804	0.783	0.764	0.792	0.805	0.790
9	0.813	0.801	0.862	0.886	0.751	0.780	0.775	0.751	0.740	0.781	0.740
10	0.796	0.781	0.845	0.872	0.751	0.765	0.775	0.742	0.733	0.781	0.710
11	0.759	0.733	0.800	0.839	0.722	0.724	0.726	0.722	0.710	.	0.660
12	0.715	0.649	0.737	0.780	0.688	0.683	0.673	0.651	0.683	.	0.610
13	0.651	0.586	0.641	0.734	0.664	0.640	0.612	0.607	0.645	.	0.610
14	0.612	0.554	0.578	0.709	0.664	0.541	0.574	0.567	0.635	.	.
15	0.548	0.513	0.448	0.673	0.664	0.491	0.506	0.535	0.596	.	.
16	0.517	0.501	0.379	0.662	0.664	0.452	0.482	0.521	0.596	.	.
17	0.478	0.489	0.271	0.650	.	0.452	0.482	0.496	0.581	.	.
18	0.458	0.489	0.193	0.650	.	0.423	0.482	0.496	0.554	.	.
19	0.458	0.467	.	0.628	.	0.423	0.482	0.496	0.512	.	.

TABLE 29. ACTUAL RETENTION RATES FOR LS PROGRAM GROUPS

YRS SVC POST AFIT	GCA	GCM	GLM	GSM
1	1.000	1.000	0.991	0.995
2	1.000	1.000	0.979	0.989
3	1.000	0.985	0.945	0.966
4	0.813	0.910	0.907	0.903
5	0.796	0.855	0.874	0.860
6	0.796	0.840	0.841	0.830
7	0.796	0.840	0.816	0.799
8	0.796	0.840	0.787	0.766
9	0.796	0.840	0.757	0.755
10	.	.	0.725	0.731
11	.	.	0.672	0.691
12	.	.	0.633	0.650
13	.	.	0.602	0.597
14	.	.	0.568	0.578
15	.	.	0.541	0.541
16	.	.	0.527	0.502
17	.	.	0.502	0.491
18	.	.	0.495	0.491
19	.	.	0.491	0.491

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13. ABSTRACT *(Maximum 200 words)*

This study analyzes the retention rates and demographics of Air Force Institute of Technology (AFIT) graduates. The sample includes 5,071 Air Force officers graduating between 1973 and 1987. Actual retention rates of AFIT graduates are compared to retention rates of mission support officers provided by the Air Force Military Personnel Center. A proportional hazards regression analysis is performed to study the relationship between specific factors and a graduate's length of service after graduating from AFIT.

The results of this analysis show that graduates of the School of Engineering (EN) are nearly two years younger, on average, than their counterparts in the School of Systems and Logistics (LS), and remain in the service an average of two years less than LS graduates. Comparisons of the actual and expected retention rates of AFIT graduates show that the retention rate of AFIT graduates is significantly higher than the USAF at large. The results of the proportional hazards regression analysis show that GPA, age at graduation, and in some cases, sex and aeronautical rating are significant factors influencing retention.

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